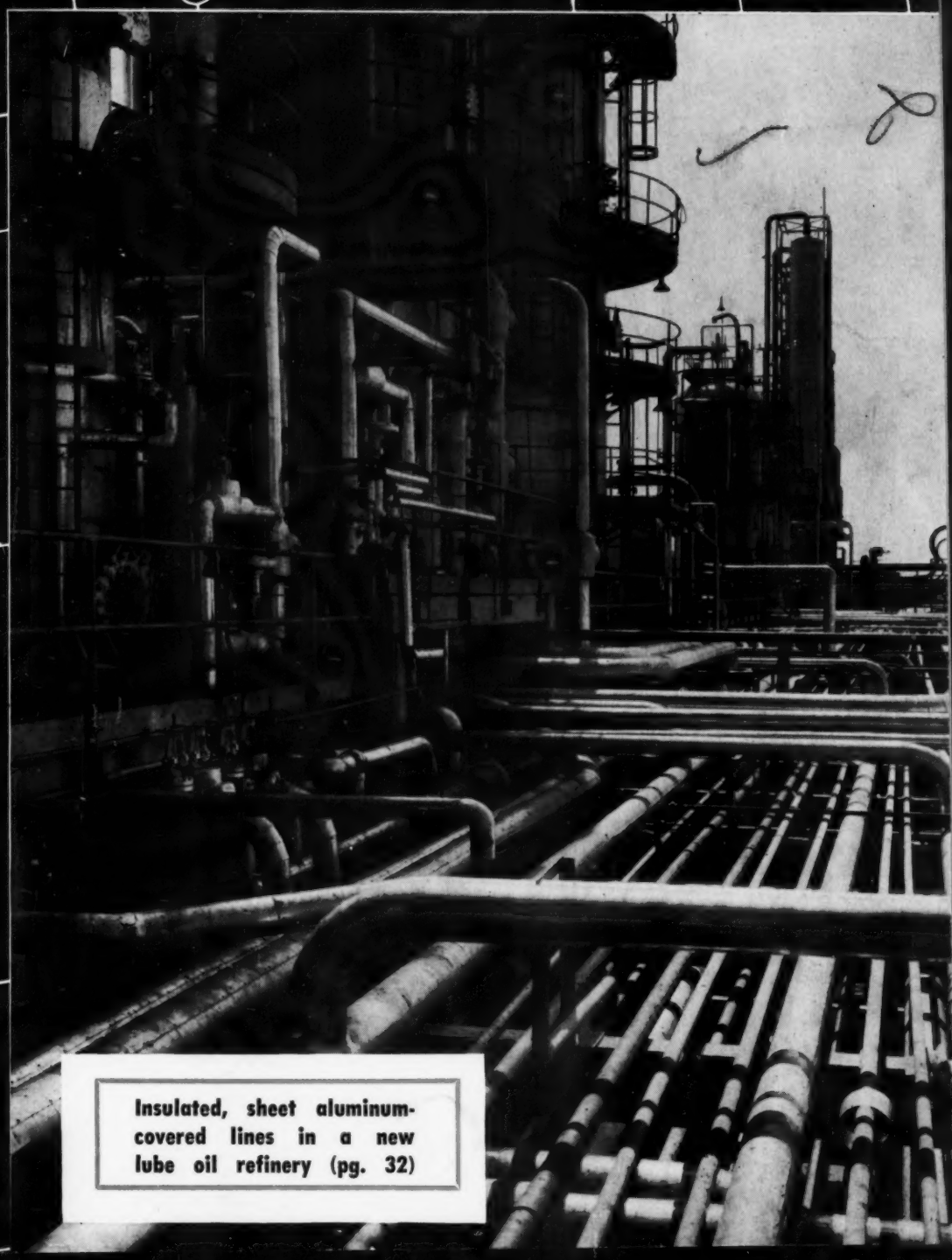
JANUARY, 1949
VOL. 4, NO. 1

PETROLEUM PROCESSING



Insulated, sheet aluminum-covered lines in a new lube oil refinery (pg. 32)

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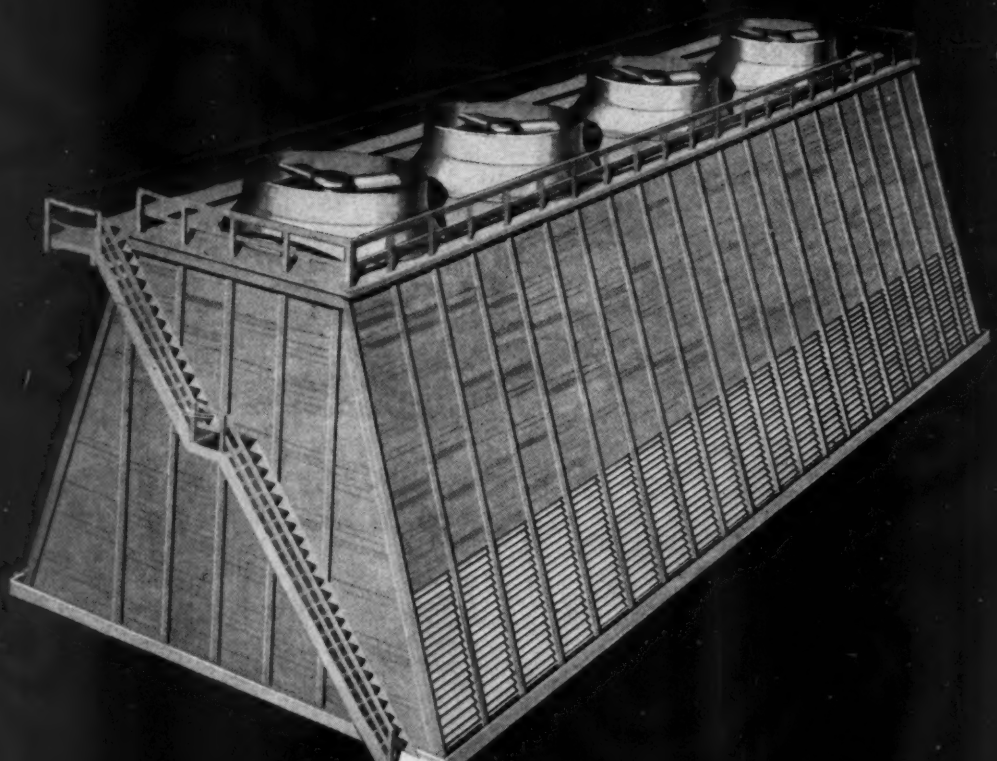

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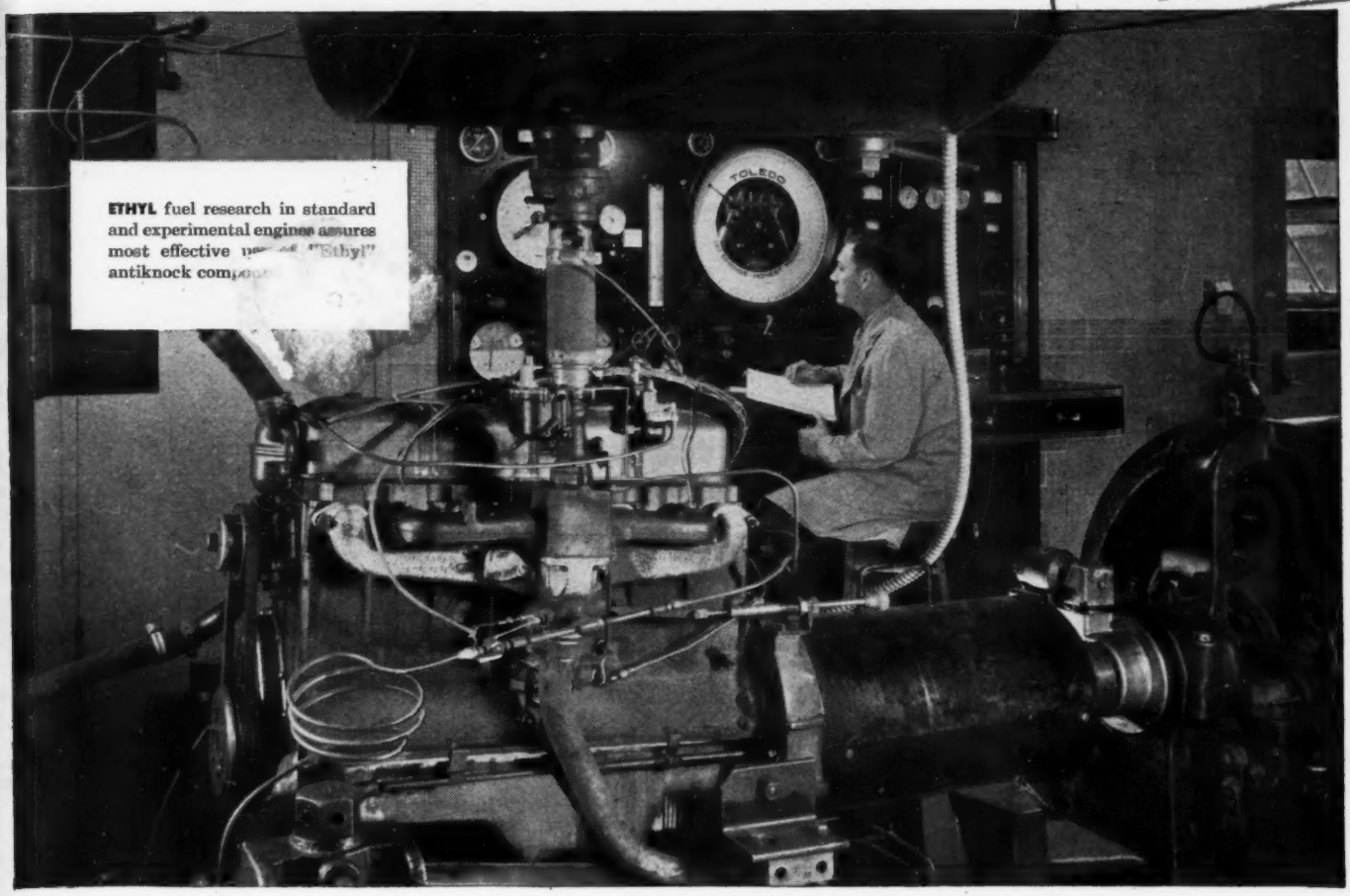

ETHYL fuel research in standard and experimental engines assures most effective use of "Ethyl" antiknock compound

Ethyl gives refiners' point of view to automotive industry

AUTOMOTIVE ENGINEERS need the latest technical information on fuels and fuel trends for guidance in the design of improved engines for tomorrow's vehicles.

The source of this technical information is the hundreds of individual companies that make up the petroleum industry. The Ethyl Research Laboratories, closely associated with the technical and refining departments of the oil companies, continuously collect and integrate information on fuels and petroleum refining. Much of this valuable information comes from over 225 oil companies, which improve their gasoline with "Ethyl" brand of antiknock compound.

A continuous program of study enables Ethyl's research staff to interpret fuel trends in terms of possible future engines. Because of the strategic location of Ethyl's modern laboratories in the center of the automotive industry, this store of technical information is available immediately for the benefit of automotive engineers.

Today the refiner is producing a larger number of components for blending base gasolines. These stocks represent many classes of hydrocarbons having a variety of molecular structures that cover a wide range of antiknock performance.

Because of the importance of analyzing and interpreting refining developments to automotive engineers, Ethyl Research Laboratories maintain close contact with both industries and cooperate in research programs having common interest. This kind of teamwork does much to assure that engines are designed to make the best use of the product provided by the oil companies.

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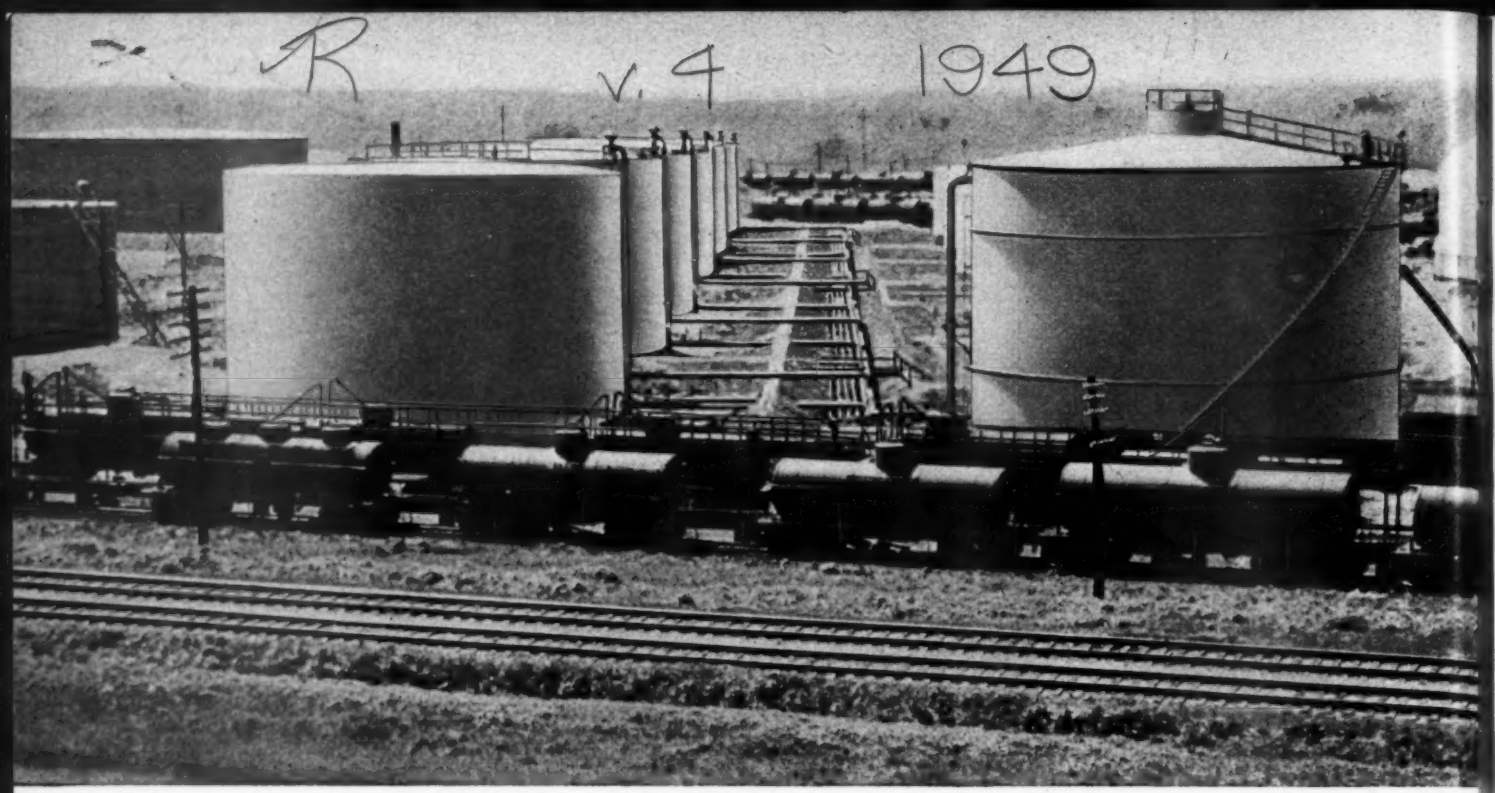

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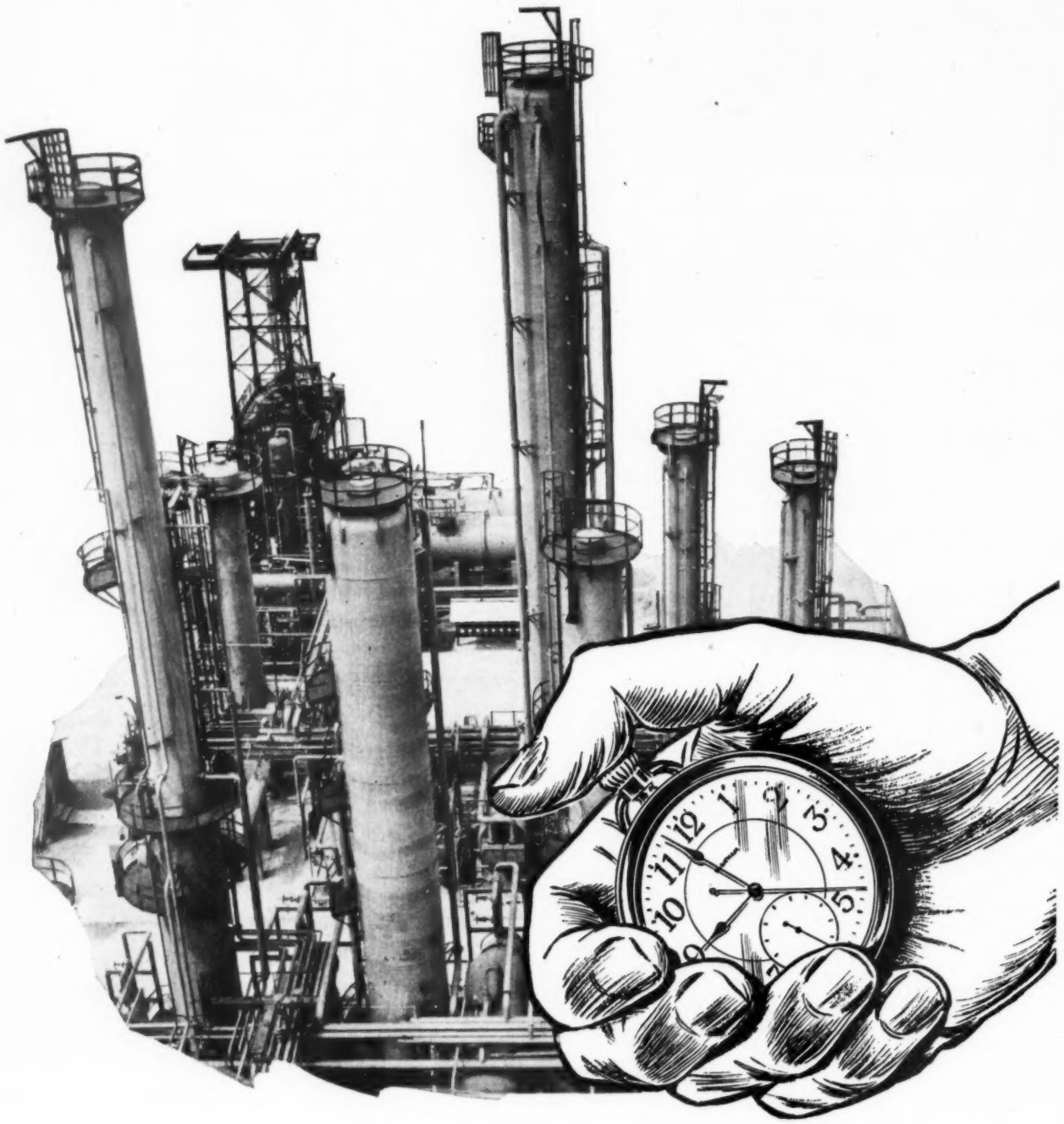
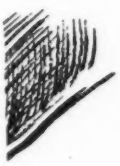
PLATT'S OILGRAM PRICES
A daily independent oil-price reporting service issues simultaneously from New York, Cleveland and Houston.



Efficiency



Put a stop watch on your operations? Perhaps. But the surest way to maintain peak production is through steady, day after day efficiency. That's where time is made or lost.

Where does efficiency begin? With the process itself . . . or with the research, the development, the engineering that lies behind plant design and layout and the evolution of operating procedure. But what keeps efficiency at its peak? Again, many of these factors plus service . . . a careful check on yield, product quality and on the physical equipment of your refinery.

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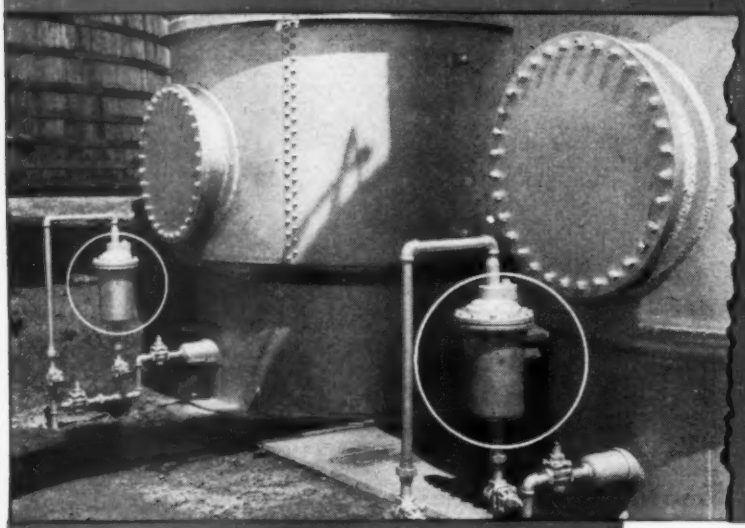

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IN INDIA . . . 350,000 tons a year of ammonium sulfate will be produced by a plant at Sindri to be operated by the Indian government.

IN EGYPT . . . every day 550 tons of calcium nitrate will flow from the great plant at Suez . . . to be built for the Societe Egyptienne d'Engrais et d'Industrie Chimiques (S. A. E.).

IN MEXICO . . . 70,000 tons of low-cost ammonium sulfate will flow from a new plant near Mexico City to be built for Guanos y Fertilizantes S. A., Mexico's leading fertilizer manufacturer.

In other strategic places throughout the world—as well as in the United States—Chemico is helping to meet the need not only for fertilizer, but also for sulfuric acid, synthetic ammonia, synthetic methanol and other heavy chemicals.

In each of these projects the Chemico organization functions as Architect-Engineers in charge of design, procurement of equipment, supervision of construction, training of personnel and initial operation.

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What's Happening!

Important Current News Summarized for Refiners

EXPANSION

Gulf Oil Corp. plans a $40,000,000 expansion of its Philadelphia refinery, boosting plant capacity from 77,000 b/d to approximately 107,000 b/d. Increased capacity will be used for processing crude from Kuwait neutral zone produced by Kuwait Oil Co., in which Gulf is one-half owner. Company has acquired 360 acres of land adjacent to present refinery site, and may eventually spend $100,000,000 on project.

Another Gulf project has been completed—a $19,000,000 expansion of its Port Arthur, Texas, refinery. New facilities include a desulfurization unit, polyform unit, and three atmospheric-vacuum topping stills. Two of three new stills will replace older shell units and third will possibly be used to add to charging capacity.

California Standard has announced plans for a 35,000 b/d refinery in Venezuela to process its crude production there. Refinery, to be located near Lake Maracaibo, is scheduled for completion in 1950.

Scottish Oils, Ltd., will spend a sum equivalent to about $30,000,000 for expansion of its existing refinery at Grangemouth, Scotland, doubling present capacity. Completion of this and a previously announced $20,000,000 petrochemical plant, to adjoin the refinery, will make Grangemouth one of the most important petroleum centers in Great Britain.

• • •

RESEARCH

Jefferson Chemical Co. has announced plans to establish at Austin, Texas, a laboratory for research in petroleum chemicals. The company, owned by The Texas Co. and American Cyanamid, has obtained a 69-acre plot near the U. of Texas' expanding research center, and will spend over $500,000 on the project.

More accurate analytical procedures involving low-temperature distillation is the aim of a cooperative research project being sponsored by the Natural Gasoline Assn. of America. Forty-one laboratories of 28 oil companies and three commercial laboratories have already agreed to participate in the program. Initial procedure will be to compare results obtained by each of these laboratories in quantitatively analyzing three series of specially prepared liquid samples which they will receive.

Objective of the program is to find out if more accurate and duplicable results can be obtained with all low-temperature distillation through minor changes in equipment and major revisions in techniques.

• • •

PRODUCTS

Change your crankcase oil in automobiles, trucks and buses only in spring and fall, or every 4000 miles, whichever comes first, Bureau of Federal Supply has recommended to all federal agencies. Recommendation was based on conclusions reached by Technical Committee on Lubricants and Liquid Fuels of Federal Specifications Board. Committee said oil changes short of 4000-mile mark are "unnecessary" under normal driving conditions and controlled preventive maintenance.

At same time, committee cautioned that shorter intervals between changes are desirable in stop-and-go service, especially in cold weather, or when sand and dust are regularly encountered.

Commercial avgas characteristics are covered in a survey just released by the Bureau of Mines. Free copy may be obtained by writing Bureau's Publications Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa., asking for RI 4435, "Survey of Commercial Aviation Gasoline Characteristics July 1948 Production."

An automobile motor oil which will remain fluid at temperatures as low as 60° below zero (F.) has been developed by Macmillan Petroleum Corp.

"Tougher on its fuel requirements" is all that company spokesman would say about report that new Chrysler engine will have a 7:1 compression ratio.

• • •

PETROCHEMICALS

Synthetic iso-octyl alcohol is now being produced by Esso Standard Oil Co. at its Baton Rouge plant. Process used, an adaptation of the German OXO process, involves reaction of a selected gasoline fraction with hydrogen and carbon monoxide in presence of

Information on these pages is obtained through the nation-wide news coverage services of PLATT'S OILGRAM NEWS

a special catalyst at a pressure of up to 3000 psi. The alcohol is expected to be a low-cost raw material for plastics manufacture.

Manufacture of formaldehyde, with smaller quantities of acetaldehyde and methanol also being produced, was expected to be started last month at McCarthy Chemical Co.'s new plant at Winne, Texas, dedicated Nov. 30. Plant will process approximately 100 million cu. ft. daily of residue gas from nearby McCarthy absorption plant, which extracts natural gasoline and butane from natural gas.

• • •

MARKETS, PRICES

Decline in products prices continued through December with a swift swing from a seller's to a buyer's market. Widespread reductions in most refining areas, stemming from top heavy supply, were featured by falling fuel quotations in the Gulf cargo market. Bunker "C" cargoes at the Gulf dropped another 25c per bbl. to $2.00, and No. 2 fuel fell 0.25c per gal. to 7.75c.

On the East Coast, No. 6 barge prices were lowered to $2.55 at New York, Baltimore and Philadelphia. Midwestern refiners' Group 3 prices for No. 6 also were down 25c to $1.05.

While regular-grade gasoline prices were 0.25c lower in the Mid-Continent and midwest, they more than held their own in the East. Esso Standard, followed by most other eastern marketers, boosted its gasoline prices 0.5c throughout its marketing territory.

First major break in domestic crude prices since the war came when South Penn Oil Co. and other buyers of Pennsylvania-Grade crudes cut their prices 50c per bbl. The move had been long awaited in view of the sharp decline in lubricating oil prices during the last five months.

The sortie by Sinclair and Phillips toward higher crude prices in the southwest proved unsuccessful. Both companies "regretfully" rescinded their 35c increases in the face of falling products prices and the stubborn resistance of other crude buyers.

Lubricating oil price decline was unchecked as export markets remained dormant. Mid-Continent conventional bright stocks of all grades were down 4 to 5c per gal., and conventional neutrals fell off 0.75 to 3c.

• • •

TRANSITION

Sinclair Refining has closed its 6000 b/d refinery at Sand Springs, Okla. This is the fourth and last of smaller Sinclair units to be closed down under company's plan to centralize refining in larger, more efficient plants. Previously closed are plants in Coffeyville and Kansas City, Kans., and Fort Worth, Texas.

Carter Oil Co.'s 2000 b/d refinery at Newcastle, Wyo., has been acquired by Consumers Cooperative Assn., boosting latter's refining capacity to about 35,000 b/d.

Midland Gasoline Co., previously owned in part by Warren Petroleum Corp., has now been acquired 100% by Warren and the Chicago Corp., and will be operated under Warren's management. Midland owns and operates a natural gasoline plant in the Conroe oil field, Texas, and is currently producing about 1000 b/d of natural gasoline and LPG.

• • •

MISCELLANY

Influenza at Gulf's Port Arthur refinery has been reduced by one-third as a result of a test program of inoculations carried out last year. Health benefits have been so pronounced that the program is being continued this year, with over 2800 employes participating to date. Inoculations are offered on a purely voluntary basis, with the refinery management assuming all expenses, including the vaccine.

Socony-Vacuum's Augusta, Kans., refinery was one of 30 firms recently cited by the American Legion for its outstanding record in employing physically handicapped war veterans.

ASTM Standards on Petroleum Products and Lubricants, 1948 edition, has just been issued, and includes important changes in all five of the ASTM Engine Test Methods for Rating Fuels. See review, pg. 99 in this issue.

• • •

PEOPLE

L. W. Moore has been elected president of Pan American Refining Corp. and Mexican Petroleum Corp. of Georgia, both subsidiaries of Pan American Petroleum & Transport Co., in turn a subsidiary of Indiana Standard. He succeeds D. J. Smith.

Adolphus G. Pilger, Jr., in charge of automotive field research for Tide Water Associated Oil Co., will receive the 1947 Horning Memorial Award from the Society of Automotive Engineers during its annual meeting in Detroit, Jan. 10-14. The award, made for a new contribution to adaptation of fuels to engines and engines to fuels, was voted to Pilger for a paper describing research which inaugurated a new technique to predict engine deposits of sludge and varnish and bearing corrosion, and which evaluates engine lubricants and gasoline when engine design factors and operating conditions are known.

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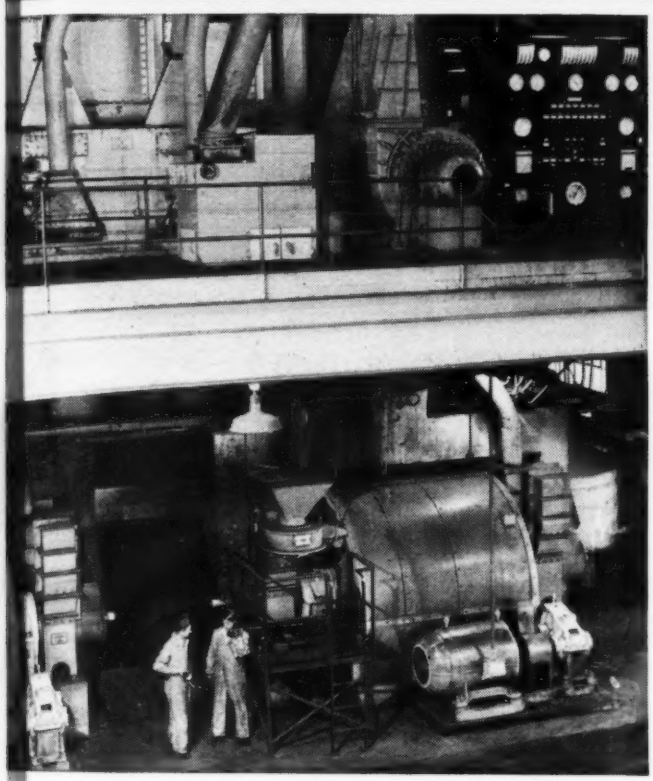

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Power engineers have found in Dowell's *chemical* scale removal service a modern method for *restoring power*. They know that more efficient operation of boilers, condensers and other heat exchange equipment has been achieved after removal of the insulating scale and sludge deposits by this tested service. They have seen for themselves how effective Dowell's service really is.

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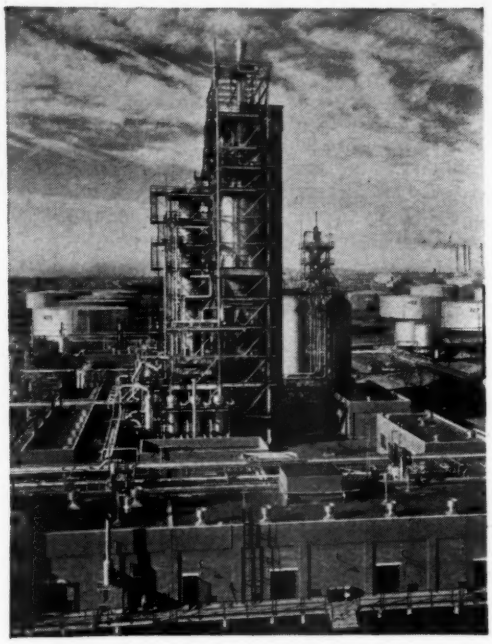
NUMBER 7 IN A SERIES

The important question in foreign refinery construction is "Which Master Contractor?"



GREAT pressure for refinery expansion and refinery modernization is now being felt in foreign fields, where both a ten year hiatus in building and major war destruction must be overcome. The new capacity required is large and presents serious capital outlay problems to both foreign national refiners and foreign subsidiaries of American companies.

The *master* contract type of operation, concentrating all engineering, material procurement and construction responsibility at any one refinery site in one organization's hands, is especially desirable in this work because of the inherent potential for major capital savings which has been established previously in this series.

Thus, the question facing refiners undertaking projects for installation outside the United States becomes not *whether* to use the *master* contract type of operation but, rather, *which* "master" contractor to engage. To clarify consideration of this latter question, Kellogg presents what it believes to be the most important factors which should be taken into account when selecting a *master* contractor for foreign work.

First, it would appear most important to select an engineer-contractor that has had repeated experience with the multitudinous responsibilities of varied types of *master* contract operations and naturally a successful record.

Further, the contractor's *existing* establishment, in manpower and resources, should be capable of handling the entire project both expeditiously and efficiently *within his own organization.*

Second, this contractor should have had experience in *foreign* operations—not necessarily at the particular location of the proposed job, but most assuredly at a sufficient number of foreign locations so that the contractor's organization shall have learned *previously* the many unusual, and in many respects more difficult, requirements of foreign operation.

Third, the contractor's design groups—laboratory, process and mechanical—should have a *secure and unquestioned engineering reputation,* eliminating any desire or need to build "monuments to advanced processing" for prestige purposes, when such refinements are not justified by immediate and specific economic need. In short, the contractor's engineers should be mentally conditioned to approach the planning of each project on one basis only—*to design facilities which will meet the immediate and foreseeable market demands and in so doing earn the most pesos, cruzeiros, dinars, pounds, or francs over a period of years for the least immediate capital outlay.*

Fourth, under present world supply conditions, the contractor's ability to perform effectively the complex and difficult *task of procurement* of materials and equipment will prove critical in accelerating the on-stream date of the plant. Maximum speed and final economy in the conduct of this responsibility requires three basic capabilities: An existing procurement group *large* enough and *experienced* enough to purchase, inspect and expedite with thoroughness and dispatch the thousands of items of material and equipment which comprise a major refinery project; an *up-to-the-minute detailed knowledge of world-wide sources of supply,* which can be maintained only through active purchasing activity carried on constantly over the years in the major markets of the world; together with the "know-how" to utilize local currencies to the utmost in the procurement phase.

Fifth, the contractor must be capable of putting into the field when construction begins, *a quality of field supervisory and technical personnel equal to the magnitude of the task* . . . men accustomed to handling large-scale field administrative problems equivalent to those of a small city . . . men equipped by education, training and experience to solve problems in the field without need for reference to home office rulings and engineering advice.

Experience is the basis for this evaluation of the major considerations to be resolved by any refiner undertaking refinery construction outside the United States. *Experience* that has paralleled the growth of the refining industry, extended over a period of some thirty years, and embraced refinery projects of all kinds in practically every corner of the globe. It is *experience* that is further substantiated by foreign contracts currently entrusted to Kellogg totalling more than a hundred million dollars embracing *21 separate projects in Argentina, Belgium, Brazil, Canada, France, the Middle East, the United Kingdom and Venezuela.*

BENNETT ARCHAMBAULT
Treasurer
In Charge of Foreign Contracts
The M. W. Kellogg Company

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Tomorrow

. . . IN PETROLEUM TECHNOLOGY

Brief reviews of currently reported technological and economic developments, in the light of their possible bearing on petroleum refining.

Coal Dresses Up the Data In Its "Facts and Figures"

COAL AND OIL have many common interests and each industry must be alert to changes which affect either or both.

Both industries are so large that their salient statistics literally fill volumes. *Petroleum Facts and Figures,* the bi-annual publication of the American Petroleum Institute is well known as a compilation of statistics which relate to the oil industry, and it is not surprising to note that the coal industry has seen fit to follow suit by preparing a similar compendium.(1)

The 1948 edition of this coal industry book is comparable in appearance and intent to the petroleum industry source book, but differs greatly in style of presentation. *Petroleum Facts and Figures* is like an almanac. To use it one must know for what to look and then see if the answer is there. Statistical tables and graphs are plentiful; descriptive and explanatory paragraphs are not included. In *Bituminous Coal Facts and Figures,* however, much explanation and exposition are included, giving the coal industry opportunity to expound upon its viewpoints and to interpret data presented.

The coal industry has skillfully used this advantage. Under the discussion on "consumption," for example, one finds many statistics (but little discussion on trends) on the use of various fuels by the railroads. What discussion is included is headed "dominant railroad fuel is coal." No misuse of statistics is made but the real picture is not clearly presented.

Moreover, in charts showing proportionate sources of energy in the U. S., what is termed "a realistic picture" is presented by omitting "the energy used in the form of gasoline and lubricants, etc., as well as the natural gas used in the production of carbon black". The data given includes only "such coal, oil, natural gas, and hydro-electric power as are consumed in direct competition." An explanation of how the figures are used is appended—but how many will read the explanation?

The section on "finance" in *Bituminous Coal Facts and Figures* would be worth the price of admission to anyone who is not an expert on the subject. As pointed out, man-hours per ton were reduced two-thirds in the bituminous industry from 1890 to 1939, but wages during that period increased five-fold. Wartime restrictions since that date prevented further mechanization while calling for record production, and "repeated wage increases during and after the war have not been offset by labor saving but instead have been reflected in higher labor costs and prices per ton. Other industries (principally the petroleum industry) have made much greater progress in reducing labor costs per unit of output." Donald R. G. Cowan, who wrote this section, feels that the coal industry must extend and improve its mechanical methods and must plow back a large part of earnings for use for capital expenditures.

Phases of the coal industry covered in this book—which, incidentally appears to be available gratis, unlike the API compendium (which sells for $2)—include reserves, production, distribution, consumption, mechanization, labor, and finance. It is "must reading" for all who would keep up with the coal industry.

(1) Anon., *Bituminous Coal Facts and Figures,* 1948 Edition, Bituminous Coal Institute, Washington, 1948. 148 pages.

Fossil Fuel Is Only "Pip" In Total Human History

ATTENTION TO FUEL and energy reserves and speculations on their life are quite the vogue today. Some "guesstimators" are concerned with more practical aspects—say the next five or ten years—but others, emulating Tennyson, are looking "far as human eye can see" into the future and are coming up with generalizations which are highly interesting but whose accuracy our descendants (barring nuclear energy elimination of the race) will alone be able to evaluate. Comment was made in the December installment of this feature on the voluminous API compendium of Eugene Ayres, but it still seems fitting to pay brief attention to another, but somewhat more restricted paper recently presented in this field.(2)

Dr. Hubbert, associate director of Shell Oil Co.'s exploration and production research division, points out the interesting fact that, even if the process of accumulating fossil fuels is still occurring at the same rate as in the past, "the accumulation during the next million years will probably not exceed 1/500th of the accumulation which has occurred" during the 500,000,000 years or so in which organisms have been "buried in the accumulations of sediments under conditions which have prevented complete disintegration and complete loss of their energy content."

Man, as such, has probably existed roughly a million years, according to Hubbert, and is distinguished from all other species by his inventiveness "of means for the conquest of a larger and larger fraction of the available energy." Until the last few centuries, however, the energy consumed per capita increased but slightly. With the advent of the industrial revolution, all this has changed. Curves of world production of coal (since 1800) and petroleum (since 1860) show tremendous increases in output, leveling off somewhat for coal (since 1920) but certainly not for oil.

As Hubbert points out, "one of the most disturbing ecological influences of recent millennia has been the human species' proclivity for the capture of energy, resulting in a progressive increase of the human population.—From a world average of 300 kilogram-calories per capita per day in 1800, the energy from coal and petroleum increased to 9880 by 1900, and to 22,100 kilogram-calories per capita per day in 1940."

In such areas of high industrialization as the U. S., the per capita energy from these sources is much larger, amounting to 114,000 kilogram-calories in this country in 1940.

Dr. Hubbert presents much interesting data on the estimated amounts of fossil fuels, for the whole purpose of his paper deals with the very real physical limits to further expansion of fuel consumption. Predicating his time-element extrapolations on these data and on two possible rate-of-use predictions, he estimates that fossil fuels may be exhausted somewhere between the years 3250 and 3750 A.D. and that the rate of consumption of these fuels will fall below present levels somewhere between the years 2650 and 2850 A.D.

Looking at water power as a nonexhaustible source of energy, Hubbert finds that maximum potential world *capacity* is perhaps 50% in excess of

(2) M. King Hubbert, *Energy from Fossil Fuels,* Paper presented at Centennial Celebration of the AAAS, Washington, September 15, 1948.

the present rate of energy consumption of fossil fuels and water power, but he believes it will be well over 100 years before utilization could catch up with present total demand levels—much less provide for increased energy usage.

"In the light of a time perspective, minus and plus, of some tens of thousands of years from the present—the consumption of energy from fossil fuels is thus seen to be but a 'pip' rising sharply from zero to a maximum, and almost as sharply declining, and thus representing but a moment in the total of human history." Energy from water power and solar radiation may prove but a similar 'pip' but can level off at a peak value equivalent to that for the fossil fuels unless cultural degeneration causes a decline "to the subsistence level of our agrarian ancestors." Human population on a similar time scale may rise abruptly to a value of several billion. Thereafter, depending upon energy supplies and cultural levels, it may level off or decline at various rates.

As Hubbert points out, "the release of this energy (from fossil fuels) is a unidirectional and irreversible process. It can happen only once, and the historical events associated with this release are necessarily without precedent, and are intrinsically incapable of repetition.—Our present position on the nearly vertical front slopes" of the curves he predicts "is a precarious one.—We have no choice but to proceed, and while our future may be unpredictable in detail we may be assured that it will be both novel and interesting!"

"Chromatography"—A New Method of Separating Liquids

CHEMICAL ENGINEERING PRINCIPLES and processes are of vital significance to the petroleum processing industry, since this industry depends largely upon them for the tools for its operations. Adsorption principles, for example, are applied by the industry in catalytic cracking, desulfurization, gasoline treatment, etc. It is no wonder, then, that a new "wrinkle" in adsorption and desorption called "chromatography" is attracting petroleum industry attention, as far already as the semi-works stage.(3)

Chromatography, briefly, employs "selective adsorption and desorption as a means of separating liquids of closely related chemical properties.—It might be more properly defined as: separation of liquids by differences in their adsorption coefficients." Until recently, chromatography was chiefly a valuable laboratory tool, particularly in biochemical work, but at least two commercial plants are now in operation (for production of plant pigments from alfalfa and purification of streptomycin), and the biochemical and petroleum industries are "actively working with it."

Typical uses of this unit operation within the petroleum industry include "upgrading of lubricating oil fractions by removal of aromatic constituents" and "the production of pure organic chemicals (such as benzene) from natural, cracked, and hydroformed crudes." According to Williams and Hightower, such petroleum refining operations offer "the biggest opportunity for chromatography — but a pall of secrecy shrouds the current research work."

These brief remarks on chromatography are too limited in scope to reveal the true significance of this new unit operation, which seems destined to play an important role in the petroleum processing field. Actual applications should be carefully noted for their potential as well as current significance.

(3) Roger Williams, Jr., and J. V. Hightower, *Chemical Engineering* 55, No. 11, 133-38 (1948).

Low-Temp. GR-S Revitalizes Synthetic Rubber Industry

THE PETROLEUM INDUSTRY by now is well aware of the most important synthetic rubber news in recent years, the fact that GR-S polymerized at low temperatures (41° F.) yields tires which give at least 30% better mileage than those made from the *best* natural rubber. It is worthwhile to note, however, some of the specific forecasts recently made by W. F. Tuley of the U. S. Rubber Co. for this new variety of GR-S. According to this authority:(4)

"1. Low temperature polymerized GR-S will displace present standard types of GR-S as rapidly as it is made available.

"2. On a quality basis, low temperature GR-S will be preferred in a substantial total volume over natural rubber even though the latter sells at a somewhat lower price.

"3. Demand for low temperature GR-S will probably exceed supply for the next 12 to 18 months and will probably not be adequate until almost all of the GR-S production facilities have been converted.

"4. There is no present indication that low temperature GR-S will, in the near future, increase the total consumption of GR-S above the present level at the expense of natural rubber.

"5. Consumers of rubber products will benefit from better performance through the use of low temperature GR-S."

By use of antifreezes, GR-S may be polymerized at satisfactory rates at 14° F. and 0° F., but "the refrigeration capacity required for 14° F. is roughly twice that at 41° F. and at 0° F. it is increased about three times." Added costs may not be prohibitive "if real additional quality is found for the lower temperatures." In any case, the new GR-S rubbers are an important development in the synthetic rubber field and virtually assure a long-term demand for petroleum-derived butadiene and styrene.

(4) W. F. Tuley, "Butadiene-Styrene Chemical Rubbers Polymerized at Low Temperatures," *Rubber Age* 64, 193-196 (1948).

The Gas Industry Sets Up Own Information Service

THE PETROLEUM INDUSTRY —or at least many of its larger companies—has long been a leader in the utilization of information services for the proper employment of technical and economic information. It is not particularly surprising, therefore, to note that the need for such services has been felt in allied fields, specifically, by the gas industry.

The Institute of Gas Technology, in Chicago, was created a number of years ago to serve the gas industry by conducting such research as was needed, by training men at the graduate level in the science and technology of the industry, and by collecting and disseminating pertinent information. To render this latter aim effective, the Institute has now activated an Information Service, headed by John C. Lane, formerly chief of the Information Section of the Chemistry Division of the Gulf Research & Development Co.

Duties of this new service will include the editing and publishing of research bulletins; the preparation of library searches and literature surveys; and the collection, classification, and co-ordination of various information sources. This service will also direct the Institute's Student Library, Reference Library, and the preparation of *Gas Abstracts*.

The proper use of published information has long been of interest throughout the world, and attention is being continuously focused upon it by the technical and scientific industries. For example, two exhibits which attracted much attention at the recent National Chemical Exposition in Chicago were those of the John Crerar Library's new Research Information Service and the Special Libraries Assoc. Moreover, the American Chemical Society, in September, gave full Division status to the field of chemical literature.

All of this information activity, within and without the petroleum industry, is a healthy sign; information is valueless unless it can be readily located for use, and only through efficient information service is this economically feasible on a large scale.

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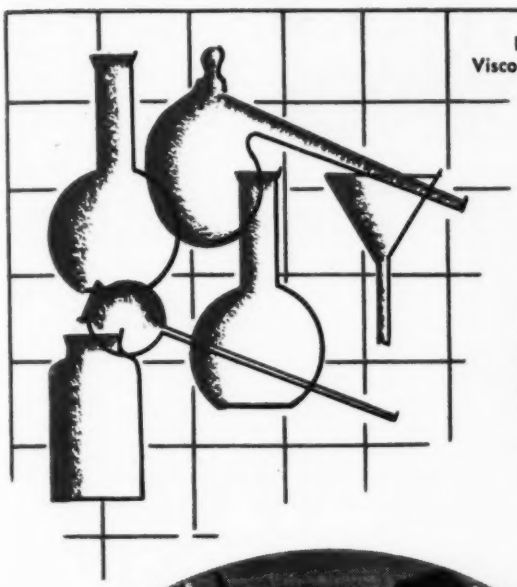

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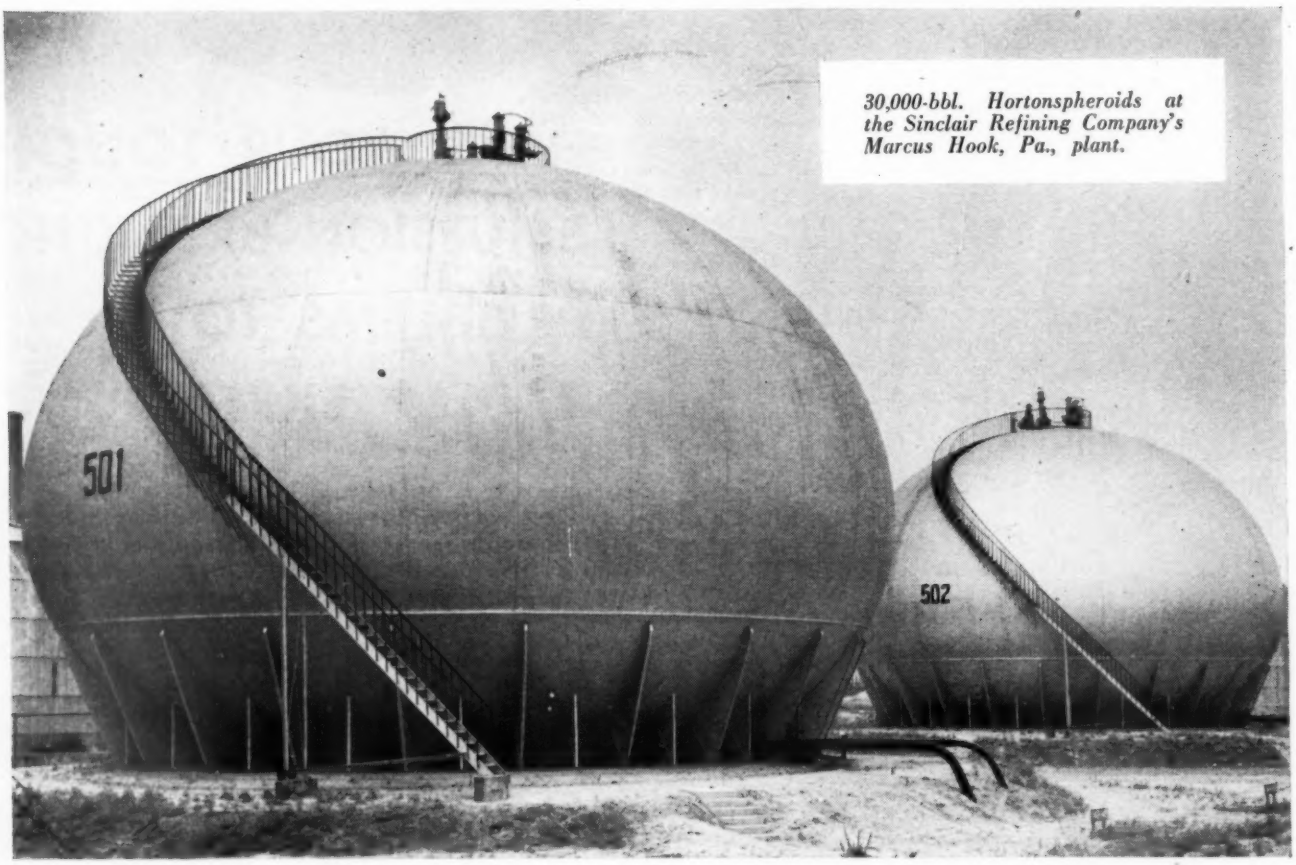

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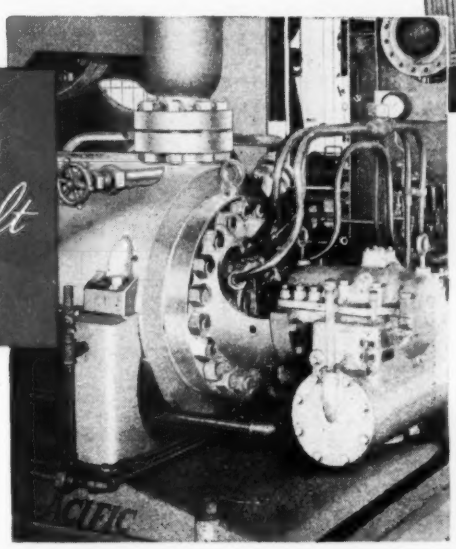

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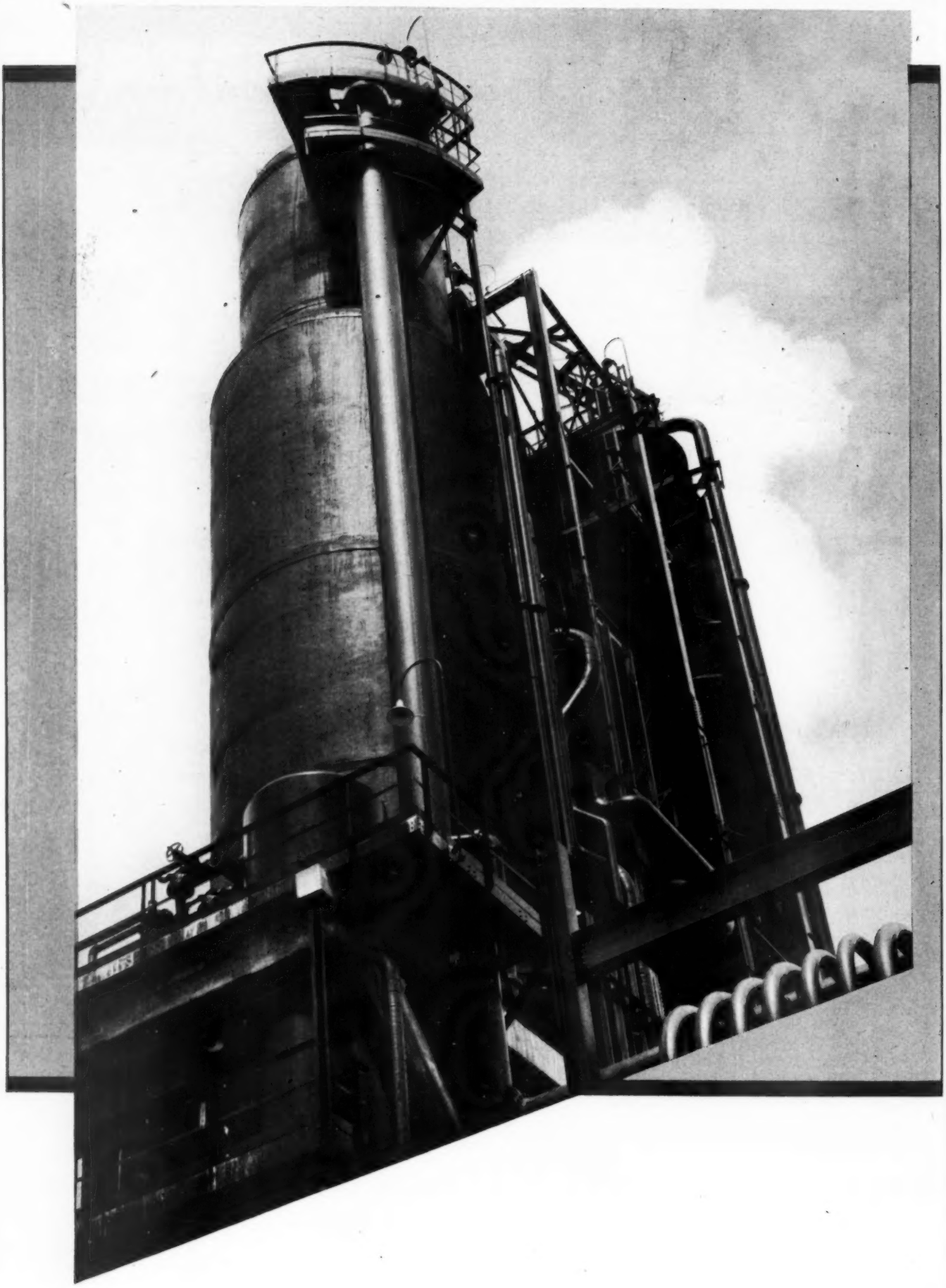

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Modern Techniques for

The Processing of Acetylene

By MARSHALL SITTIG
Chemical Engineer, Bangor, Maine

Wartime technological developments in acetylene manufacture in Germany have been the basis for further study in this country. The work here has included the recovery of acetylene from petroleum hydrocarbons by the arc process, by fluidized bed, and by Hypersorption. Safety problems in the manufacture and handling of acetylene are reviewed. Some of the products by various types of reactions are discussed. A comprehensive listing of literature references is given.

NOW that most of the reports on wartime developments in Germany have been issued, it would seem fruitful to pause and assess the developments in acetylene technology during the last 30 years.

The period under discussion was ushered in by a Catholic priest, Father Julius A. Nieuwland, when he first identified divinylacetylene in the reaction products obtained when acetylene gas was bubbled through a solution of cuprous chloride containing ammonium chloride.

It is ironic to note, in contrast, that the most recently developed reactions of acetylene were discovered and developed by Walter Reppe, a confirmed Nazi and staunch supporter of Hitler's war machine.

The work of these two men, together with that of the duPont chemists and engineers who enlarged upon Nieuwland's discovery — and with Reppe's staff, mark the two outstanding milestones in the use of acetylene as a chemical raw material since it was first prepared by Davy in 1837, over a century ago.

The most spectacular developments were those made in Germany under the impetus of wartime desperation. These so-called Reppe reactions may be divided into the following classes:

1. Introduction of the C=C vinyl group into—
   a. Alcohols giving vinyl ethers
   b. Amines giving vinyl amines
   c. HCN giving vinyl cyanide
   d. Aromatic nuclei giving vinyl aryl compounds
2. Introduction of the C=C ethynyl group into—
   a. Aldehydes giving acetylenic alcohols
   b. Aldehydes giving -inediols, or acetylenic glycols.
3. Carbonylation—
   a. With CO to give acrylic acid
4. Cyclic polymerization—
   a. To cyclooctatetraene

These syntheses were carried out in many instances under pressures of 5-20 atmospheres and at temperatures up to 250° C. with complete safety. Such reaction conditions are in sharp contrast with accepted prewar practice in this country, which limited operations to about 2 atm. pressure at less than 100°C.

No less an achievement than the development of these reaction tech-

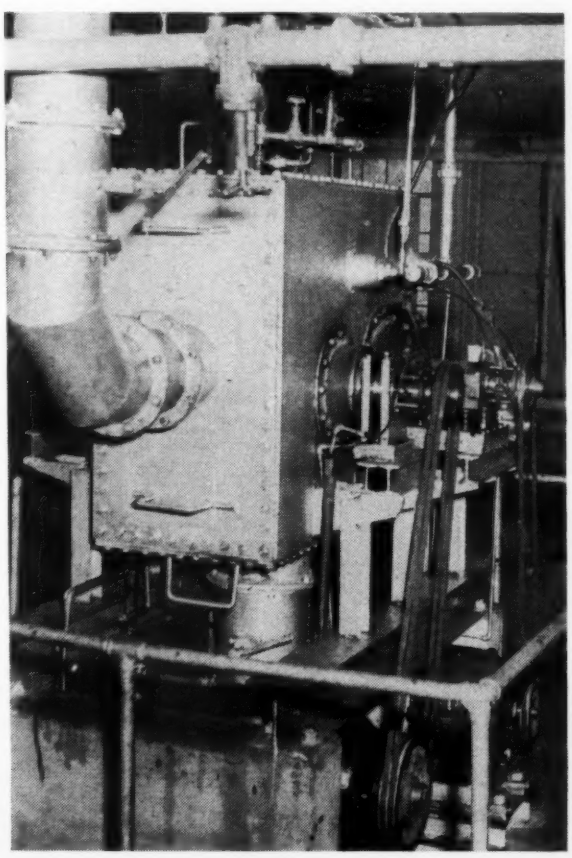

Fig. 1 — Electric discharge unit (pilot plant scale) of the Schoch arc process for producing acetylene from methane. The pilot plant installation at the University of Texas, Austin, can handle 1000-1500 cu. ft. of natural gas per hour, producing 150-225 cu. ft. of acetylene of 99% purity.

niques, however, were advances made in acetylene manufacture and purification. In the I. G. Farbenindustrie plant at Huls, in Germany, the arc process[1] was employed, although other regenerative-type cracking processes were also developed[2]. Actually 85% of the acetylene produced in Germany during the war period was made from calcium carbide by conventional techniques, the arc process accounting for the major portion of the remaining 15%[3].

The high point of the acetylene manufacturing process was the concentration of the arc acetylene product from 16% C_2H_2 to 96% C_2H_2 by water scrubbing[4]. The scrubbing operation was conducted at 18 atm. pressure, 4-stage reciprocating compressors being used to compress the cracked gas feed. Intercoolers were used between stages to hold temperatures at the end of each stage below 100° C.

Removal of higher acetylenics from the concentrated acetylene was regarded as a very hazardous operation by the Germans. A low-temperature refrigeration process was used, with ethylene as the refrigerant, and pure C_2H_2 from this final step was used to effect a preliminary condensation, giving a condensate which was diluted with benzene, and with water to hasten polymerization, and ditched. The final condensate contained 40% C_2H_2 at −65° C. and gave up its acetylene upon heating to −40° C. (5% C_2H_2). These low-temperature coolers were mounted in individual concrete enclosures with walls 3 to 5 feet thick and open at the top. No one was allowed in the enclosures during operation, controls being manipulated from the outside.

Work on acetylene manufacture from petroleum hydrocarbons, as opposed to the traditional calcium carbide process, is the subject of much current research in this country. The Schoch arc process, developed at the University of Texas, is now slated for its first commercial installation[5]. See Figs. 1 and 2. Fluidized bed processes for acetylene manufacture are also under study[6]. Hypersorption has been advanced as a means of recovering acetylene from hydrocarbon pyrolysis gases.

The question of handling acetylene commercially as a chemical raw material largely resolves itself into a question of operating safely and preventing explosions with their attendant property damage and loss of life. Acetylene is an endothermic compound, which in homely words means it is happier split into carbon and hydrogen than tied together as acetylene. Hence, thermal or mechanical shock can initiate decomposition of acetylene into its elements. Successful plant design for acetylene handling requires, first, that these initiators be eliminated, and, second, that provision be made for halting flames once they are kindled, before they can rupture the apparatus. Under means of accomplishing the first objective, elimination of initiators, we have the following:

1. Elimination of chemical detonators such as acetylides, peroxides, diacetylene, etc.
2. Temperature control
3. Pressure control
4. Proper grounding of equipment
5. Incorporation of diluents such as nitrogen, other hydrocarbons, etc.
6. Control of moisture content
7. Avoidance of piping configurations which may lead to decompositions (sharp elbows e.g.)

Once one of these initiators starts a slow decomposition, a flame front will proceed down a pipeline and, depending on the degree of turbulence, among other factors, it may or may not become a detonation. Various types of flame arrestors may be used to quench the flame already formed and prevent damage other than a shutdown to clean soot out of the equipment.

Metallic Derivatives Dangerous

One of the greatest dangers in acetylene handling comes from the metallic derivatives of acetylene, the acetylides[7, 8]. Copper, silver, and mercury acetylides are particularly hazardous. Moist copper metal will react with pure acetylene[7]. Thus valves or other movable members in equipment handling acetylene must be constructed of iron or nickel, and copper or copper alloys must be scrupulously avoided, unless acidity is controlled to prevent acetylide formation.

Another major source of hazard in acetylene handling, particularly in those operations where acetylene polymers may occur, is peroxide formation.

Thermal decomposition of pure acetylene will occur upon heating to temperatures of the order of 500° C. Increased temperature in the lower ranges may not initiate decomposition in itself but will make initiation by another agent more likely.

The pressure at which acetylene decomposition may occur is conditioned by many factors. It is affected by vessel diameter, pure dry acetylene at 15° C. being stable below 1.8 atm. in 0.2-in. tubes and below 1.4 atm. in 0.8-in. tubes. Above 0.8 in., diameter has no further effect[4]. It is also a function of initial acetylene temperature, being stable below 1.4 atm. absolute pressure at 15° C., and below 1.06 atm. absolute at 180° C. Igniter temperature also has a

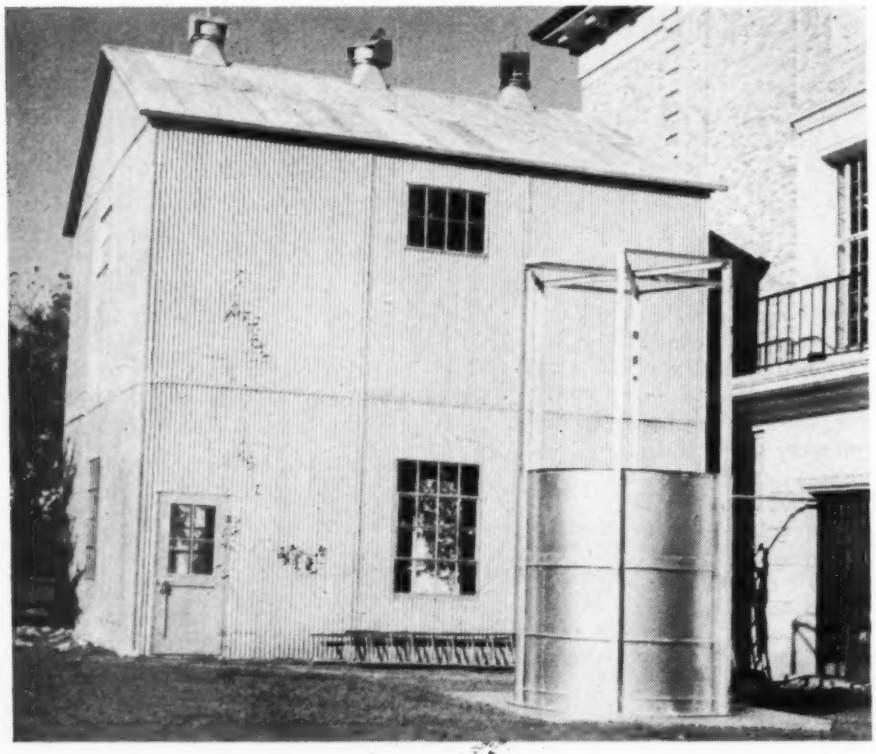

Fig. 2—The sheet iron building, of the Schoch arc process pilot plant installation, houses the equipment for concentrating the acetylene from the electric discharge unit.

marked effect, results obtained by Dr. Boesler of the I.G.(4) showing that 1.4 atm. absolute press was required to initiate a decomposition in a large chamber with platinum or molybdenum wire igniters at temperatures over 1700° C. Aluminum wire igniters (660° C.) required a pressure of 2.65 atm. absolute, and lead (330° C.) required 7.50 atm. absolute.

Work has been reported recently by Bureau of Mines' chemists on the effect of diluent gases in preventing acetylene explosions(9). The effectiveness of hydrocarbon diluents was found to increase with the molecular weight of the hydrocarbon. Nitrogen, helium, and hydrogen were found to be of the same order of effectiveness, all of them quite inferior to CO_2 or natural gas. At 100 psi. gage, 30% propane was found to render acetylent non-explosive, as did 40% natural gas or 60% helium. Platinum fuse wires were used as igniters. It was concluded that absorption of heat in hydrocarbon cracking was effective in preventing acetylene decomposition, and that thermal conductivity of the diluent gas had little effect.

The effect of moisture content on explosibility of C_2H_2 has been studied by the Bureau of Mines, largely in an effort to improve the safety of portable acetylene generators used in shipyards. These tests were conducted at low temperatures and pressures, but showed the presence of a lower threshold pressure, below which acetylene could not be ignited by a platinum fuse wire. At 30° C., the threshold pressure was found to be 7.2 psi.; at 50° C., 7.9 psi.; at 70° C., 16.0 psi.(10). Although air is usually avoided in acetylene processing systems, it is interesting to note that these same experiments showed that the upper limit of explosibility with air rises with increasing pressure, reaching 100% at a value slightly above 7 psi. gage.

In work with dry acetylene at 18 atm. pressure, German investigators had trouble with elbows in pipe lines. An elbow would heat up, become red hot, and soften and split open in 15-20 minutes(4).

Liquid Even More Dangerous

All of the discussion up to this point has concerned gaseous acetylene. Liquid acetylene is a much more dangerous compound(7) and considerable effort has been expended on the preparation of stable mixtures containing liquid C_2H_2(11).

Oddly enough, German investigators have found(11) that solid acetylene is relatively insensitive to shock, friction, flame, and heat—burning slowly with soot formation.

Let us return now, however, to a consideration of specific examples of wartime achievements in German acetylene technology(12). At the beginning of this article, vinylation was listed as the first major class of these reactions. These are reactions of acetylene with a compound having an active hydrogen atom, wherein the hydrogen adds to one end of the triple bond and the balance of the active hydrogen compound to the other end. Among the products produced in Germany by the vinylation reaction were:

TABLE 1—Products by Vinylation Reaction of Acetylene

Product	Raw Materials	Catalyst	Temp. Cent.	Pressure Atm.	% N_2 Diluent
Acrylonitrile	C_2H_2—HCN	Cu_2Cl_2—KCl—H_2O	70°	..	..
Koresin	C_2H_2—i-Bu Phenol	Zn Naphthenate	200°	20	67
Luvican	C_2H_2—Carbazole	ZnO, KOH	250°	20	67
Vinyl Ethers	C_2H_2—Alcohols	KOH	150–180°	0–20	67
Vinyl Chloride	C_2H_2—Hcl	$HgCl_2$/C	120–200°	..	..

1. Koresin—a tackifier for Buna S synthetic rubber(13, 14)—by nuclear vinylation of phenol with acetylene, using a zinc naphthenate catalyst, and polymerization of the resultant vinyl compound.

2. Periston—a substitute for blood plasma(15)—by vinylation of the sodium salt of pyrrolidone to give N-vinyl pyrrolidone as the monomer from which the polymeric Periston is prepared.

3. Luvican—a mica substitute and synthetic asbestos material(16)—by vinylation of carbazole to N-vinyl carbazole, which serves as a raw material for the synthetic resin product. It is interesting to compare Luvican with polymerized 2-vinyl dibenzofuran which was the synthetic mica developed by General Electric in this country during the war(17).

4. Lumitol—a vinyl ester product made by the reaction of acetylene and tall oil acids(18).

5. Oppanol C—a polymer of isobutyl vinyl ether, whose monomer is made from isobutyl alcohol and acetylene(4, 15).

6. Neurine—vinyl trimethyl ammonium hydroxide—from trimethyl amine and acetylene.

7. Acrylonitrile from HCN and acetylene.

8. Vinyl chloride from HCl and acetylene.

Table 1 summarizes some of the essential features of the processes employed in the manufacture of some of these products.

The second major class of reactions carried out on an industrial scale in wartime Germany was ethynylation, or the introduction of a triple bond into an organic compound. Reaction of one molecule of acetylene with formaldehyde to give propargyl alcohol, and reaction of two molecules of acetylene with formaldehyde to give butinediol, were both practiced. The latter reaction was emphasized since it gave a new route to butadiene for synthetic rubber manufacture.

Manufacture of Butinediol

The alternate routes to butadiene made possible by advances in acetylene technology are illustrated in Fig. 3.

Copper acetylide was the catalyst employed in butinediol synthesis(4, 13, 19, 20, 21, 22, 23) at Ludwigshafen. It was supported on silica gel, and a small amount of bismuth was incorporated with the copper salt to inhibit cuprene formation and accelerate the butinediol reaction. Reaction conditions were 100° C. temperature and 5 atmospheres pressure. Safe operation of the tower-type packed reactor, with this inherently hazardous catalyst, was assured by maintenance of a high liquid flow rate, and good liquor distribution to avoid hot spots. The feed liquor was a 15% aqueous solution of formaldehyde.

Annu'ar acetylene distributors were provided at four levels so acetylene could be fed in above a hot spot to cause evaporative cooling. Many temperature check points were provided in the catalyst bed. The equipment was designed to hold 100 atm.

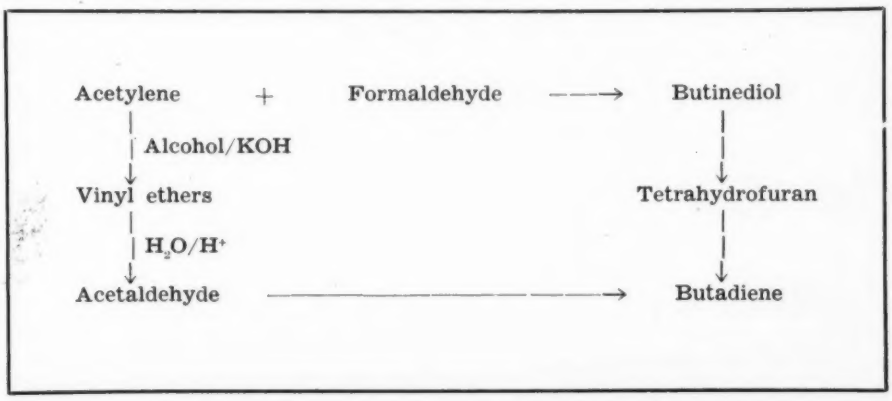

Fig. 3—Alternate routes, acetylene to butadiene

pressure, or 20 times the normal operating pressure. As noted in Table 1, most of the vinylation reactions already discussed were conducted with a considerable proportion of nitrogen as a diluent. In contrast, the butinediol reaction was conducted with pure acetylene. All piping, including elbows, were filled with small multiple tubes. All larger spaces, such as the dished heads of the reactor, were filled with Raschig rings. Butinediol was manufactured in Germany on a scale approaching 50,000 tons per year[24].

The third major class of reactions represented in German applied acetylene technology was carbonylation. Here we have an expression of the "building-block chemistry" which Reppe advocated, whereby a great variety of chemical intermediates could be synthesized from low molecular weight "building blocks", such as acetylene and CO.

In semi-works operation at Ludwigshafen, 30-50 tons per month of ethyl acrylate were produced from ethanol and acetylene in the presence of nickel carbonyl, the nickel carbonyl being continuously regenerated by CO. Acetylene and water gave acrylic acid[25, 26, 27, 28].

The fourth major class of wartime German acetylene reactions involved cyclic polymerization to cyclooctatetraene (COT)[29, 30]. A nickel cyanide catalyst suspended in tetrahydrofuran was used by Reppe and his co-workers at 15-20 atm. and 70°-150° C. to convert acetylene to COT. Calcium carbide and ethylene oxide were found to act as catalysts. Cuprene and benzene were also among the products of this reaction.

Straight polymerization, as opposed to cyclic polymerization to COT, gives the vinylacetylenes as commercially important products.

Monovinylacetylene (MVA) has long been utilized as an intermediate in the manufacture of Neoprene synthetic rubber in this country as an aftermath of Father Nieuwland's discovery, as discussed at the beginning of this paper. Very little has been published on this DuPont process, however, and the patent literature[31, 32] gives the only details, aside from those contained in a pictorial flow sheet in one journal[33].

Russian work on MVA manufacture, in the course of preparation of Sovprene synthetic rubber, has been described[34].

In the recent war, as a natural consequence of intensive German concentration on acetylene utilization, the Germans made chloroprene polymers by way of MVA as in intermediate[35]. Reaction conditions employed were 1 atm. gage pressure and 70° C. temperature. A vertical tower-type, enamel-lined steel reactor was used, with a Cu_2Cl_2-NH_4Cl catalyst contained therein.

In addition to the broad general classes of acetylene reactions which have been discussed up to this point, various other isolated examples of recent developme..ts are of interest.

Work has continued on the catalytic hydration of acetylene to acetone, and on improved methods of manufacturing Lewisite, which was originally made by bubbling acetylene through a mixture of $AsCl_3$ and $AlCl_3$.

It has been reported that acetylene and fuming nitric acid give nitroform which can be converted to tetranitromethane.

We have mentioned Reppe's work on acrylic ester manufacture from acetylene and CO. Another very interesting acrylic ester synthesis, developed in this country, based on acetylene and acetone, has been described in the literature[36].

The new vistas opened up by these wartime developments in acetylene technology, when coupled with American research and production facilities, should indeed go far to make acetylene one of our more common fundamental chemical raw materials.

Report Available on Chlorinated Hydrocarbons

A report on German production of chlorinated hydrocarbons from acetylene, covering operations and equipment not described in previous reports on this subject is now available from the Office of Technical Services of the Department of Commerce.

Alexander Wacker A. G. at Burghausen and I. G. Farben plant at Rheinfelden, two of the more successful German plants now operating, are described in detail. Flow sheets, schematic drawings and, in some cases, production costs for most of the chlorinated compounds are provided; in addition, processes are described giving actual quantities of materials used rather than simply summaries of operations.

PB 75813, *Chlorinated Hydrocarbons from Acetylene,* 62 pages including charts and tables, sells for $2 per copy, and deals with the following more important and better known chlorinated hydrocarbons: tetrachlorethane, trichlorethane, and pentachlorethane, perchlorethylene, hexachlorethane, cis - and trans-dichlorethylene and vinylchloride. Orders should be addressed to the Office of Technical Services, Department of Commerce, Washington 25, D. C., accompanied by check or money order payable to the Treasurer of the United States.

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Short-Cut Process Design Methods For Higher Propane Recovery

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Sanderson-Glendening, Consulting Engineers, Houston

Article I

The literature is replete with methods of designing the various portions of natural gasoline and cycling plant facilities—i.e., absorption, desorption, fractionation, refrigeration and the like. Unfortunately, little has been published on rapid methods which will give sufficient accuracy for basic design assumptions, estimating purposes and economic studies where several approaches may be under consideration.

Messrs. Glendening and Sanderson, consulting engineers, have drawn extensively on their process design experience in preparing a discussion treating the various unit processes encountered in natural gasoline manufacturing operations, especially applicable to increasing propane recoveries in new or existing plants. Emphasis is on rapid methods using algebraic formulations, rather than graphical solutions and highly accurate but generally detailed and time-consuming calculating procedures.

THE past few years have seen a great increase in the market for propane. Since this hydrocarbon is most economically recovered from natural gases, it is obvious that the natural gasoline industry is the most logical source of supply. With this in mind, most operators are actively considering means of expanding both their throughput and their percent recovery. Also, plants now under construction are designed for recoveries that were considered uneconomical ten years ago. In order to appreciate the changes in processing which this has brought about, let us look first at the older and more conventional type plant.

There was very little variation in most plants built prior to the war. Usually only two products were of interest—natural gasoline and LPG, or liquefied petroleum gas. Design was based primarily on the butane recovery desired, and the propane recovered depended upon the type of fuel to be marketed as LPG. This led to relatively low propane recovery; 20% propane and 80% butane might be considered typical depending, of course, on the composition of gas feed to the plant.

A simplified process flow diagram for this type of plant is shown in Fig. 1. The wet gas is first contacted with an absorption oil in the main absorber. The rich oil from this unit is then flashed to eliminate unwanted methane and ethane as completely as possible. The flashed vapors are recontacted with absorption oil to recover whatever heavier products may have been carried along with the lighter gases. Note that the flash tank and reabsorber are shown here as separate vessels only to indicate flows more clearly. In practice there is no need of this and rich oil may be flashed directly into the bottom of the reabsorber. Raw gasoline is separated from absorption oil in the still and run through a stabilizer, producing specification gasoline as the bottom product and LPG as the top product. Uncondensed still overhead vapors are recompressed and recycled to the base of the reabsorber. Any uncondensed overhead from the stabilizer is usually used as plant fuel.

Propane Recovery Limited

This process, with efficient recompression and reabsorption, may recover about 30% propane and 85% butane on the average. However, this system is not satisfactory for the recovery of propane in excess of 55 or 60% by the seemingly simple expedients of (a) increasing the absorber pressure, (b) increasing the absorption oil circulation, or (c) using a lighter absorption oil, for the following reasons:

(a) Increasing the absorber pressure results in a proportionally greater increase in the extractions of methane and ethane than of propane. This fact may be explained by noting that the equilibrium constants of methane and ethane decrease more rapidly with an increase in pressure than do those of the heavier components. This effect is particularly noticeable in the higher pressure range, above 800 psig., where the equilibrium constants of the heavier components actually reverse their trends and increase with an increase in pressure. Another undesirable feature of high pressure operation is the appreciable loss of absorption oil from retrograde vaporization.

(b) Increasing oil circulation also results in a proportionally greater increase in the extraction rates of

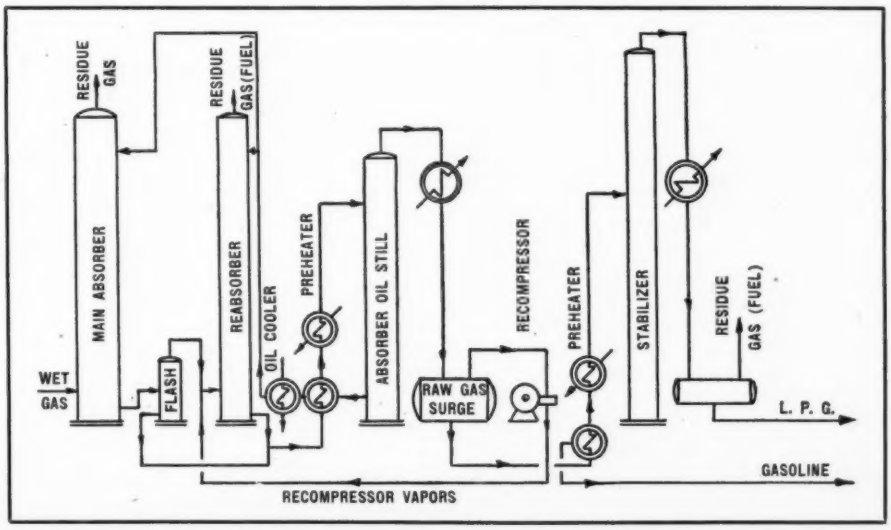

Fig. 1—Simplified flow diagram of a conventional natural gasoline plant

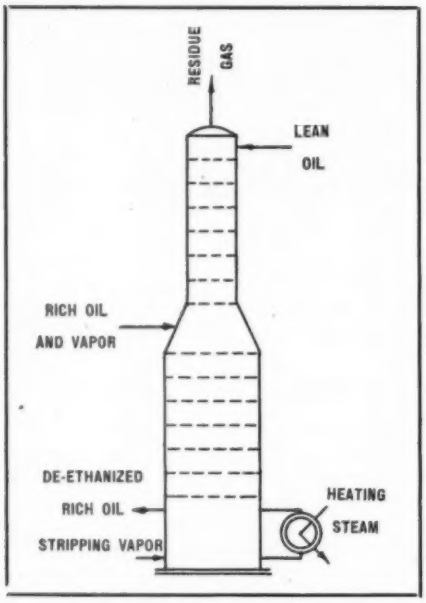

Fig. 2—Rich oil de-ethanizer

the lighter components. This is due chiefly to the fact that most of the heavier components (butane and heavier) are recovered at relatively low oil circulations, and most of the increased recovery at higher circulations must come from the light components.

(c) Using a lighter absorption oil increases extraction rates since, for a given volume of oil pumped, the molal ratio of liquid to vapor is increased. Such increases, however, are limited by the greater volatility of the lighter oil and by the consequent increase in necessary absorption oil make-up.

At high propane recoveries the conventional plant is unable to handle the greatly increased quantities of absorbed methane and ethane. Even after several stages of flashing and reabsorption (more than one reabsorber is sometimes used where the main absorber operates at very high pressure) the amount of these light ends remaining in the raw gasoline would necessitate a large recompressor installation. Reabsorber oil circulation might become excessive because of the recycling of recompressor vapors through the reabsorber and still. Furthermore, an undue amount of propane may be lost overhead from the stabilizer or any subsequent fractionating system. Of course, the recompressor vapors may be reduced by increasing the still pressure, but even a moderate increase in pressure requires a large increase in the amount of still stripping steam.

Many process modifications have been developed to overcome these difficulties, four of which will be discussed in this and subsequent articles in this series. These are:

(1) The usual process with the substitution of a rich oil de-ethanizer for the reabsorber.

(2) The usual process with the addition of a fractionating de-ethanizer using refrigerated reflux and the refrigeration of absorption oil.

(3) The conventional process with the addition of a multi-stage distillation and a fractionating de-ethanizer.

(4) Direct gas fractionation with refrigerated reflux (sometimes called vapor rectification), which replaces the absorption and distillation systems of the conventional plant.

The available technical literature abounds with accurate but frequently highly tedious methods of calculating various unit operations. On the other hand, there is a remarkable shortage of published information with regard to shortcut techniques yielding solutions necessary for estimating purposes. When bidding for contracts, estimates must frequently be prepared with a rapidity that would horrify a physicist or engineer with a primarily theoretical background. Furthermore, since some bids will be lost, the process engineer must expect to design several plants for every one he actually builds. Hence he cannot justify the use of extremely detailed design procedures in plant estimates when more rapid methods are available which will be sufficiently accurate for estimating purposes.

Therefore the emphasis in this series of articles will be on shortcut calculation methods. However, reference will be made to more elaborate methods wherever these may be appropriate.

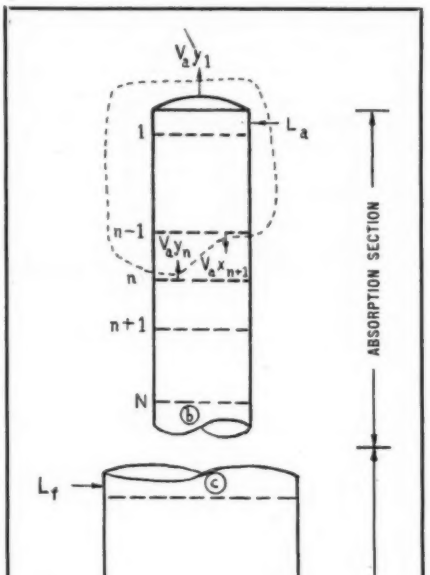

Fig. 3—Material balance on rich oil de-ethanizer

The Rich Oil De-ethanizer

The rich oil de-ethanizer (Fig. 2) is actually two towers combined into one unit. Its bottle-like shape is due to the much greater flow of oil below the feed point than above. The upper section resembles an ordinary reabsorber, since a lean oil is fed into the top and a rich gas enters the bottom. The bottom is comparable to an ordinary stripper, in that a rich oil is fed into the top and a stripping vapor of steam and/or hydrocarbon is admitted to the bottom. Propane will be absorbed in preference to ethane in the absorption section and the ethane will be more easily stripped in the stripping section. Thus it is possible to retain most of the propane in the rich oil while eliminating all of the methane and practically all of the ethane. By this means a raw gasoline of relatively low vapor pressure may be obtained and recompressor vapors will be eliminated or held to a minimum. Furthermore, since this tower de-ethanizes raw gasoline, no further de-ethanizing equipment will be required (such as a fractionating de-ethanizer, to be discussed in a subsequent article).

In the following design calculations these preliminary assumptions are made:

(1) The absorbed components are a negligibly small fraction of the oil at any particular point in the column.

(2) The stripped components are a negligibly small fraction of the vapor at any particular point in the column.

(3) Temperature is constant in each of the two sections.

(4) The stripping vapor is entirely free of the components being considered.

(5) The lean oil is completely stripped of the components to be absorbed.

Suitable corrections will be indicated for the instances where these assumptions are not valid.

Graphical Design Method

A material balance around the upper envelope in Fig. 3 gives Equation 1:

$$V_a y_n = L_a x_{n-1} + V_a y_1, \text{ or}$$
$$y_n = (L_a/V_a) x_{n-1} + y_1 \quad \ldots\ldots\ldots (1)$$

(Editor's Note: The nomenclature used in design calculations and

graphical solutions in this article is given on pg. 30).

A similar material balance around the lower envelope gives Equation 2:

$$L_s x_{m-1} = V_s y_m + L_a x_M, \text{ or}$$
$$y_m = (L_s/V_s)x_{m-1} - (L_a/V_s)x_M \quad (2)$$

These two equations relate the compositions of the vapor off any plate and the liquid from the plate above, and are used to plot operating lines on an x vs. y diagram, such as Fig. 4. Equilibrium lines relating liquid and vapor compositions leaving any plate are plotted on the same diagram from the equation defining the equilibrium constant, Equation 3:

$$y = Kx \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The procedure is to assume the terminal compositions from a material balance, an L/V ratio for each section, the temperature in each section, and the column pressure. Then by use of Equations 1, 2 and 3 two sets of diagrams are made up, one for each key component (in this case ethane and propane). Due to the preliminary assumptions the operating lines will be straight.

For the absorption section the operating line will have a slope of L_a/V_a and an intercept at ($x = 0$; $y = y_1$). The stripping section operating line will have a slope of L_s/V_s and an intercept at ($x = x_M$; $y = 0$). The equilibrium lines will pass through the origin with slopes equal to K_a and K_s depending on the temperatures assumed in each section. The final assumption is that of the compositions at point "b".

The number of theoretical plates in the absorption section is obtained by stepping down the diagram between the operating and equilibrium lines (actually, going up the column) until the composition at y_1 is reached. Then the composition at "c" is obtained by adding the oil from the absorption section to the rich oil feed. The number of theoretical plates in the stripping section is obtained by stepping down the diagram to the composition at x_M. According to the illustration given, eight theoretical plates will be required; three in the absorption section and five in the stripping section. If the proper composition has been assumed at point "b", this same number and distribution of plates also will satisfy the terminal conditions required for the other key component. Successive assumptions must be made until these requirements are met.

It is evident from the foregoing outline that the graphical method is tedious. While the construction of these diagrams is probably of interest from the viewpoint of appreciation of the actual component distribution in a column, the time involved is usually not justified in commercial design. Actually, for the design of a rich oil de-ethanizer the above calculations would be only a first approximation, since the error in assuming constant liquid and vapor in each section may be appreciable. So the results of the first approximation would be used to correct the equilibrium curves, and the entire trial-and-error process repeated.

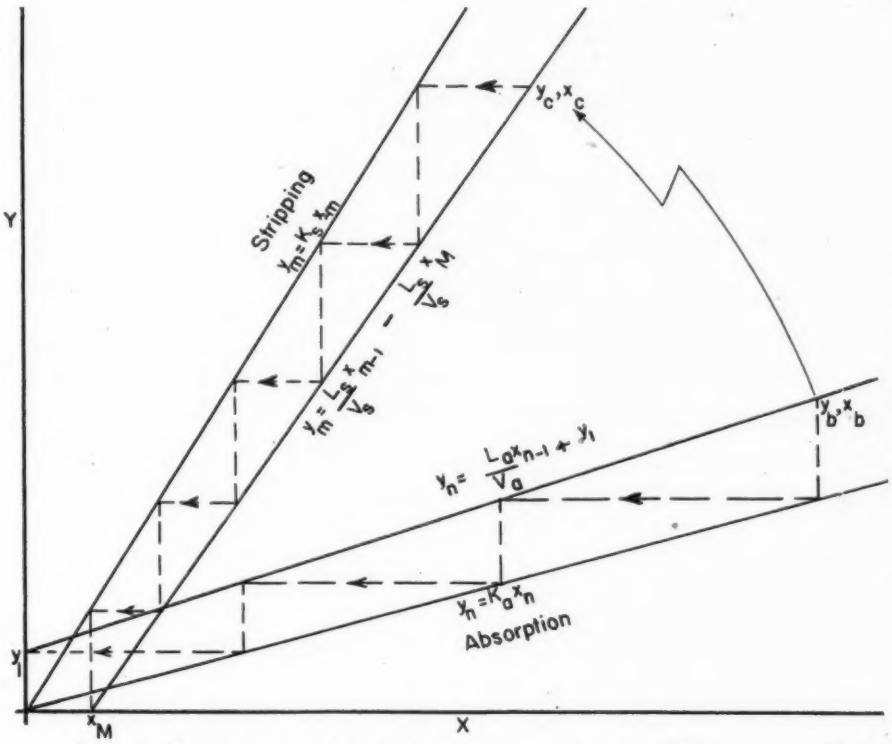

Fig. 4—Absorption and stripping diagram for one key component

Certainly all this is a powerful argument for the use of a more direct method. The following algebraic solution is much more useful and, although not eliminating the trial-error completely, at least reduces it to reasonable proportions.

Algebraic Design Method

The Kremser equation[1] applied to the absorption section gives Equation 4:

$$\frac{y_b - y_1}{y_b - y_1^*} = \frac{A^{N+1} - A}{A^{N+1} - 1} \quad \ldots\ldots (4)$$

where:

y_b = mol fraction of component in vapor entering absorption section,

y_1 = mol fraction of component in vapor leaving absorption section,

y_1^* = mol fraction of component in the vapor leaving the absorption section which would be in equilibrium with the amount of the same component in the entering lean oil at that point,

A = the absorption factor (L_a/K_aV_a), and

N = the total number of theoretical plates in the absorption section.

Since we have assumed that the lean oil entering the absorption section is completely stripped, the quantity y_1^* will be zero and the left side of Equation 4 becomes the fraction of the component entering the absorption section which is absorbed. For convenience, this fraction will be called E_a. Similarly, since the right hand member of Equation 4 is a function of the absorption factor, it will be referred to as $f(A)$. Equation 4 then becomes:

$$E_a = f(A) \quad \ldots\ldots\ldots\ldots\ldots\ldots (4a)$$

The same equation applied to the stripping section will be:

$$\frac{x_c - x_M}{x_c - x_M^*} = \frac{S^{M+1} - S}{S^{M+1} - 1} \quad \ldots\ldots\ldots (5)$$

where:

x_c = mol fraction of component in rich oil entering stripping section,

x_M = mol fraction of component in the oil leaving the stripping section,

x_M^* = mol fraction of component in the oil leaving the stripping section which would be in equilibrium with the amount of the same component in the stripping vapor entering at that point,

S = the stripping factor (K_sV_s/L_s), and

M = the total number of theoretical plates in the stripping section.

Since the stripping vapor has been assumed to contain none of the component to be stripped, x_M^* will equal zero and the left side of Equation 5 represents the fraction of the component stripped from the rich oil. Calling this quantity E_s and the right hand member of the same equation $f(S)$, Equation 5 reduces to:

$$E_s = f(S) \quad \ldots\ldots\ldots\ldots\ldots\ldots (5a)$$

The following material balances may be written on examination of Fig. 3:

$$v_b = v_f + v_c \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$
$$l_c = l_f + l_b \quad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$
$$l_b = E_a v_b \quad \ldots\ldots\ldots\ldots\ldots\ldots (8)$$
$$v_c = E_s l_c \quad \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

where:

l_b = mols/hr. component in liquid leaving absorption section.

l_c = mols/hr. component in liquid entering stripping section.

l_f = mols/hr. component in liquid portion of feed to column.

v_b = mols/hr. component in vapor entering absorption section.

v_c = mols/hr. component in vapor leaving stripping section, and

v_f = mols/hr. component in vapor portion of feed to column.

Substituting Equation 6 into Equation 8 gives:

$$l_b = E_a(v_f + v_c) \quad \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

Substituting Equation 9 into Equation 10 gives:

$$l_b = E_a(v_f + E_s l_c) \quad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Rearranging Equation 7 and substituting for l_b in Equation 11 gives:

$$l_c - l_f = E_a(v_f + E_s l_c) \quad \ldots\ldots\ldots\ldots\ldots\ldots (12)$$

and solving for l_c:

$$l_c = \frac{l_f + E_a v_f}{1 - E_a E_s} \quad \ldots\ldots\ldots\ldots\ldots\ldots (13)$$

From the definition of E_s a material balance on stripping section gives:

$$l_M = l_c(1 - E_s') \quad \ldots\ldots\ldots\ldots\ldots\ldots (14)$$

where l_M = mols/hr. component in liquid leaving stripping section.

Substituting Equation 13 into equation 14 gives:

$$l_M = \frac{(l_f + E_a v_f)(1 - E_s)}{1 - E_a E_s} \quad \ldots\ldots\ldots\ldots\ldots\ldots (15)$$

This gives a relationship affording a direct solution for the mols per hour of component in the bottoms in terms of the amount of the component in the liquid and vapor portions of the feed, the absorption and stripping factors and the number of absorption and stripping plates. However, in the usual design problem the l_M for propane and ethane are fixed, and the problem is to find the liquid and vapor quantities corresponding to an assumed number of theoretical plates. This entails a trial-and-error procedure, but the time required is greatly reduced by absorption or stripping factor charts relating $f(A)$ to A or $f(S)$ to S. Such charts are available in the N.G.S.M.A. Handbook[2] or several of the standard reference books. In addition, a consistent method of trials greatly expedites the work.

Before illustrating the procedure it will be well to review a method of correcting for the inconstancy of the liquid and vapor quantities throughout any one section of the tower. The scheme used[3] is one whereby the absorption and stripping factors are computed at the rich end of each section (at "b" and "c"), and a graphical correction applied. The equilibrium relationship is re-written in terms of stoichiometric units.

For the absorption section we now have:

$$y = \frac{Y'}{\Sigma Y'};\quad x = \frac{X'}{(1 + \Sigma X')}$$

therefore:

$$Y' = \frac{KX'(\Sigma Y')}{(1 + \Sigma X')} \quad \ldots\ldots\ldots\ldots\ldots\ldots (16)$$

where:

X' = mol ratio: mols component per mol of lean oil, and

Y' = mol ratio: mols component per mol of entering gas.

Differentiating Equation 16 with respect to X', it can be seen that the slope of the equilibrium line at the lean end (X' and $\Sigma X' = 0$) is equal to $K_a(\Sigma Y_1')$. The rest of the equilibrium line may be located by solving Equation 16 for the X' in equilibrium with the incoming wet gas. This establishes a point on the equilibrium curve and the latter may then be drawn by starting at origin with a line of the proper slope and passing the curve through this point.

The stripping section is treated similarly, but using a slightly different system of molal stoichiometric units:

$$Y'' = \frac{KX''(1 + \Sigma Y'')}{\Sigma X''} \quad \ldots\ldots\ldots\ldots\ldots\ldots (17)$$

where:

Y'' = mol ratio: mols of component per mol of stripping vapor, and

X'' = mol ratio: mols of component per mol of rich oil feed.

The slope of the equilibrium curve at the origin is $K_s/\Sigma X''_M$ and the curve is constructed as before. The entire procedure will be clarified by an example, to be presented in the second article of this series.

Nomenclature

The symbols and nomenclature below have been used in deriving design formulae and graphical solutions throughout this and installments of the series to follow.

A = Absorption factor (L/KV).

E = Fraction of component absorbed or stripped from an entering stream.

K = Equilibrium Constant (y/x).

L = Mols per hour of liquid at any point.

M = Total number of theoretical trays in the stripping section.

N = Total number of theoretical trays in the absorption section.

S = Stripping factor (KV/L).

V = Mols per hour of vapor at any point.

X = Molal ratio: mols of component per mol of lean oil.

Y = Molal ratio: mols of component per mol of entering gas.

l = Mols per hour of component in the liquid phase.

v = Mols per hour of component in the vapor phase.

x = Mol fraction of component in the liquid phase.

y = Mol fraction of component in the vapor phase.

Superscripts

$*$ = Denotes the equilibrium state.

$'$ = Refers to the absorption section.

$''$ = Refers to the stripping section.

Subscripts

a = Refers to the absorption section.

b = Refers to the point just below the bottom plate in the absorption section.

c = Refers to the point just above the top plate in the stripping section.

f = Refers to feed.

M = Refers to the stream leaving the bottom plate in the stripping section.

m = Refers to any plate in the stripping section.

n = Refers to any plate in the absorption section.

s = Refers to the stripping section.

1 = Refers to the top plate in the absorption section.

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(2) Natural Gasoline Supply Men's Assn., "Technical Manual for the Natural Gasoline and Cycling Industries," 5th Edition (1946).

(3) Sherwood, T. K. "Absorption and Extraction," Chap. IV, McGraw-Hill (1937).

Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

Data in answer to questions presented on these pages is supplied through the cooperation of authorities with the equipment and engineering companies of the Natural Gasoline Supply Mens Assn., among others. Readers are invited to submit queries on plant operating problems in their own work.

Trouble has been experienced with burnt-out windings of electric motors in intermittent service, such as cooling tower circulation and wells. Motors are adequately sized for the application and the proper current and lubrication requirements have been met. What is the cause and how can it be eliminated?

Undoubtedly motors giving trouble of this description go unoperated for long periods, then suddenly and inexplicably burn out although they have not been excessively loaded. The trouble generally is due to deterioration of the insulation on the windings caused by moisture, even though the motor may not be in an "outdoor" location or is protected from the elements.

The moisture enters by condensation from the air, such as the familiar dew or "sweating." The trouble is more frequently encountered following periods of sustained high humidity, during which the motor has been idle or used only for short periods. The moisture attracts dust and often chemical fumes as well.

No motor insulation ever developed can be expected to resist this attack indefinitely, yet it is impractical to build a motor impervious to the entry of atmospheric moisture or dirt.

Depending on the motor, its insulation, the current and the environment, it may take weeks, months or years before the attack damages the insulation sufficiently to permit a short-circuit to occur.

The easiest preventive is to start the motor at least twice a month, allowing it to run for as long a time as practical. To be effective, this should be at least several hours, so that the motor windings get thoroughly warm and dry out.

If, due to the specific application, it is not possible to run the motor often or long enough to keep moisture out of the windings, or where an excessively damp location is involved, provide some means of external heating which will maintain a temperature in the motor windings above the atmospheric dew point. It is generally less expensive and often most desirable to use an electric space heater, with or without thermostatic control as the circumstances may dictate. Steam heat is satisfactory if available and a gas fire is permissible, provided the safety requirements of the area are met.

If the motor is of the "totally-enclosed" type, the matter of drains should be investigated should the motor not come equipped with them. Be sure they are adequately sized for the circumstances. Obviously, if drains are permitted to become clogged with foreign matter, their protection value to the motor becomes nil. An inspection interval should be set up on this basis, although the actual period will depend on the individual circumstances involved.

Regardless of whether the motor has drains or not, is run periodically to dry it out or is protected by a space heater, it should be scheduled for disassembly and clean-up at least every two years. Not only should lubrication be replaced (because moisture can condense there, too) and the internals inspected for deterioration, but the windings should be freed of dirt accumulations and dried out.

Drying may be accomplished as previously mentioned by running the motor for several hours, with a hot air blast, or in an oven. A cleaning solution recommended by the manufacturer should be employed for windings although some maintenance men prefer a solvent of carbon tetrachloride in kerosine.

As a final protection, a fresh coat of any good air-drying synthetic varnish should be applied with a brush to the exposed portions of the windings, using care not to encroach upon the proper clearance between running parts of the motor.—Ray F. Riddle, Riddle & Hubbell, Manufacturers Representatives, Tulsa.

What is the better pump for fractionator reflux service — a horizontal type or the vertical deepwell pump?

It is generally preferable to use a horizontal process type pump for tower reflux than the so-called vertical deep well type pump. However, conditions may be encountered where the vertical type is preferable. The situation boils down simply to this: If the reflux accumulator can be located a sufficient distance above the pump to provide it with adequate suction head—the so-called NPSH—for the liquid involved, then the horizontal pump is the one to use.

The horizontal pump is initially much lower in price and is much easier to maintain. The horizontal process type pump recommended for this service is so constructed that maintenance or even extensive parts replacement and repairs can be performed by competent plant mechanics without difficulty or special tools. Also, because of its location the horizontal pump is easily accessible for this work.

The deep well pump has the advantage in that the suction can be as far below ground level as is required to give the necessary NPSH. On the other hand it must be sent to a specialty shop or returned to the manufacturer for extensive maintenance or repair since it requires special "know-how" to properly service it.

There is one alternative, especially when handling small quantities at high suction pressures, and that is the use of the so-called close-clearance simplex pump, which again has a much lower initial cost than the deep well type and is extremely simple to maintain.

The choice between the deep well and the horizontal process pump is one of original planning, and the careful consideration of the overall economic factors involved.—Paul L. Armstrong, Union Steam Pump Sales Co., Los Angeles. (C.N.G.A. "Information Please" Session, Oct. 8.)

MODERN SOLVENT REFINING OF LUBRICATING OILS

Article 2

By V. A. KALICHEVSKY
Consulting Chemical Engineer, Magnolia Petroleum Co., Beaumont

In the general consideration of solvent processes in lube oil manufacture, the fact that the effect of solvents is often overlapping gives additional importance to setting up the proper sequence of refining steps. Advantages of solvent refining over sulfuric acid treating are discussed briefly. Fundamental principles of propane deasphalting are reviewed. The intricate structure of wax present in oil and the fact the structure may change under temperature and other conditions adds to the complexity of the dewaxing step.

Article 3, to appear in the February *Petroleum Processing*, will discuss solvent dewaxing methods and the principles for calculating the desirable solvent-to-oil ratio in solvent lube oil refining, among other points.

General Aspects of Solvent Refining

FINISHED lubricating oils should be free of all materials which have an adverse effect on their performance characteristics. This usually means removal of asphalt, low viscosity index constituents and wax. Distillate stocks which are freed of asphalt during distillation do not need to be deasphalted and require only the last two treating steps, Because of wide variations in the properties of crude oils and product specifications, it is occasionally possible to eliminate some of the treating procedures. For instance Coastal distillates may contain practically no wax while some of the residual oils, like those arising from Pennsylvania crudes, are almost free of asphalt, making superfluous their removal from the respective stocks. However, in the case of Pennsylvania residua propane treatment may be desirable for eliminating resins and thus reducing the load on percolation filters.

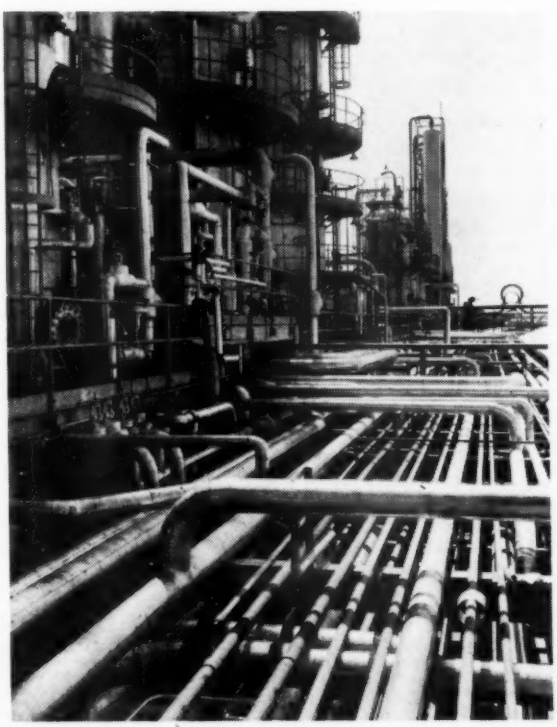
When crude oil arrives at the refinery it is distilled to remove the light fractions. The portion of the crude left in the still and known as long residuum may be processed as such or subjected to vacuum distillation. The resulting short residuum and distillate stock are then processed separately. The second alternative offers a greater flexibility in the preparation of finished products of variable viscosity ranges and degree of refining and permits segregation of paraffin wax associated with distillate stocks from micro-crystalline wax found in residua. The last consideration is of importance to refineries interested in marketing waxes or lacking in modern dewaxing equipment.

Occasionally all the oil is distilled leaving in the still an asphaltic residue. Such an operation is common with Coastal crudes which have relatively low boiling points. These heavy distillates are often referred to as overhead cylinder stocks. As they may contain both types of waxes their dewaxing by the old conventional methods is extremely difficult if not impossible, although they can easily be handled by the modern solvent processes. Considering that distillates and residua of different viscosity ranges can be obtained in the course of distillation and that each stock may need special handling, the magnitude of the problem arising before the refiner who is interested in securing the highest possible quality product at minimum cost becomes self-evident. It is also apparent that the operating pattern will vary from one refinery to another depending on local conditions.

Assuming that all of the solvents involved are capable of accomplish-

THIS MONTH'S COVER

One of the newest lube oil plants is that of Shell Oil Co., Houston. This view of the pipe rack serving the deasphalting and phenol extraction units illustrates one unusual feature of the plant's construction — use of aluminum sheeting for wrapping all insuated pipes and vessels. Sheets 3 ft. by 10 ft. and 4 ft. by 10 ft. were used, 0.025 in. thick for pipes, whether inside or out, and 0.032 in. thick on towers, vessels and exchangers. Design and construction was by M. W. Kellogg Co.



ing perfect separation between the desirable and undesirable constituents, the order in which they are applied to the oil would be of secondary importance. However, the effect of solvents is often overlapping and the discarded oil fractions normally contain some of the occluded or dissolved materials which belong to the refined phase. For instance, if dewaxing precedes other refining steps wax will be contaminated with asphalt, from which it can be separated only with great difficulty even in the laboratory. Furthermore during the subsequent treats the remaining small quantities of wax will concentrate in the refined oil, raising its pour point. In order to meet specifications the raw fractions must be dewaxed more drastically than the refined oil, which involves additional refrigeration, and the savings obtained by discarding the unrefined as compared to the refined oil occluded by the wax are usually insufficient to balance the overall processing cost.

If deasphalting follows the solvent refining step the colloidal asphalt particles will distribute between the extract and raffinate phases raising their viscosities, increasing the emulsification tendencies and unfavorably affecting the ease of separation into two layers. The efficiency of the solvent refining equipment and its throughput capacity are thus considerably reduced. In addition the removed asphalt will contain some of the expensive refined oil.

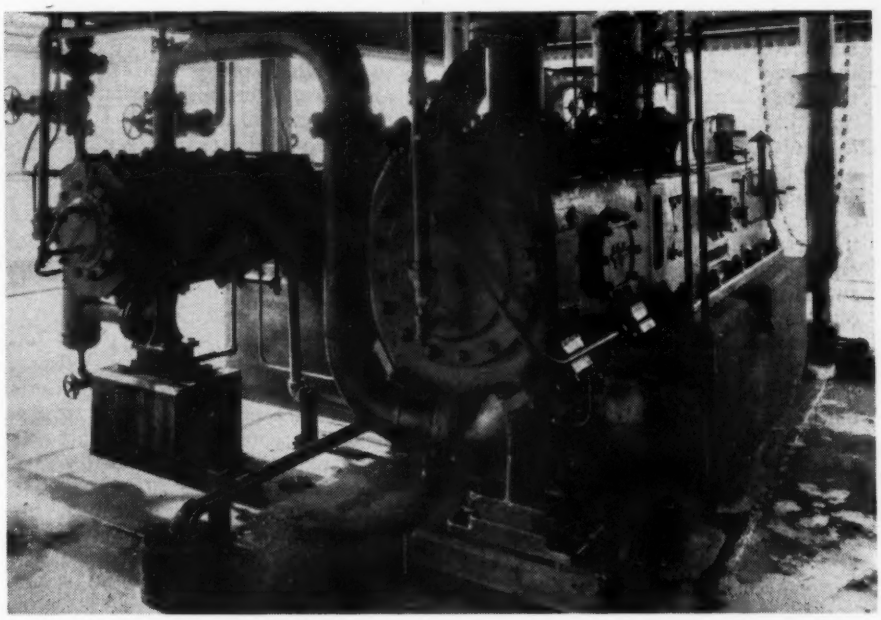
Oils extracted with solvents are often finished with clay. Percolation or contact methods may be employed and the choice between the two depends on local conditions. Percolation is a batch process embodying some of the counter-current flow principles, while contacting is a continuous process of the parallel flow type. A complete description of the two processes may be found elsewhere[4] but it might be mentioned that whenever processing of a large number of small batches of oil is involved the contact process is at a disadvantage because of the necessity of slopping appreciable volumes of materials.

The solvent refining methods quickly supplanted but did not entirely eliminate the conventional sulfuric acid treatment. This is explained by the fact that in some instances very small quantities of acid are sufficient to secure oils of the desired quality while in others the sufuric acid treated products may show better service characteristics.

In selective solvent refining a minimum volume of solvent is necessary to obtain separation into two phases. For this reason the loss of oil to the extract cannot be brought below a certain figure which might be higher than that which would be incurred in sulfuric acid refining to prepare the desired quality product. Although the solvent extract has some potential value while the acid sludge might be considered as waste, the differential cost of the two may not be sufficient to revert the balance in favor of solvents. Besides, in meeting certain specifications, such as color, sulfuric acid is frequently much more efficient than solvent and its combined physical and chemical action on the oil may occasionally produce better materials than those secured by the purely physical action of solvents. For this reason a thorough investigation is needed before one process is substituted for the other.

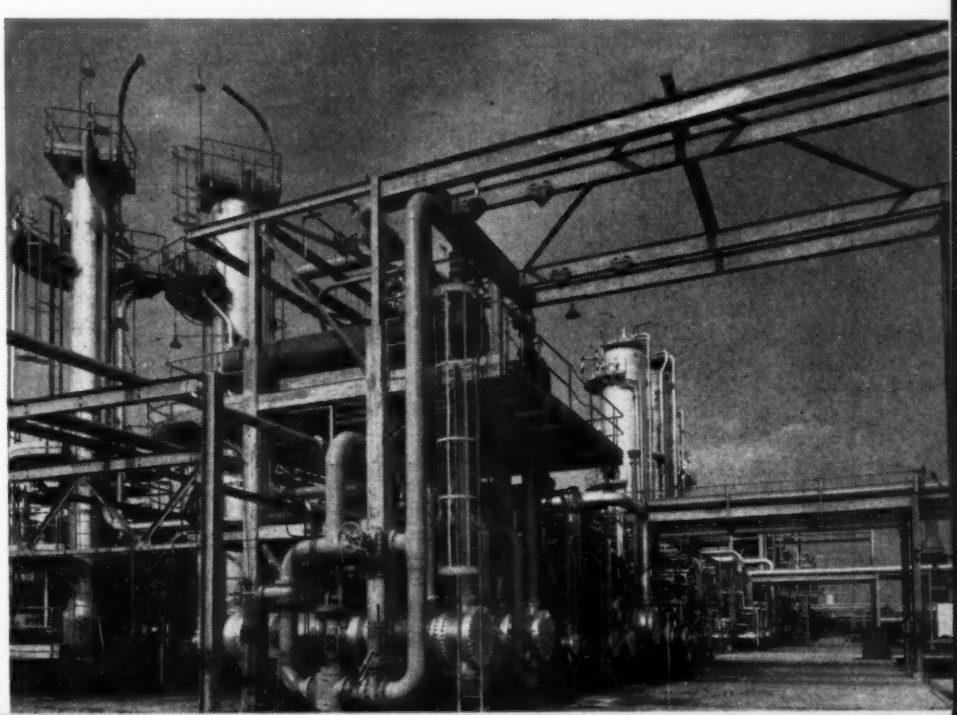
It may be added that comparisons between sulfuric acid and solvent treats are made by using economical quantities of the two reagents. However, if this consideration is disregarded and the quantity of acid is increased, the two products begin to approach each other in many properties, although they may not necessarily become identical because of the chemical effect of the acid.

When the solvent refined oils first appeared on the market their overall quality was much superior to that of the sulphuric acid treated oils but in some respects, such as in their corrosion characteristics, they were found to be inferior. It was soon discovered that these shortcomings



Propane compressor installation in pumphouse of Shell Oil Co.'s new propane deasphalting unit at Houston

General view of Shell's propane deasphalting unit. Note overhead cranes installed to facilitate handling heat exchanger tube bundles



could be corrected by the use of additives. Further work divulged that almost any property might be improved by incorporating into the oil small quantities of various chemicals. As a result the mineral oils began to acquire the status of a vehicle for such chemicals and their inhibitor or additive response became of primary importance. In this respect the solvent refined products are generally superior to the sulfuric acid treated oils, and this is of considerable economic value to the refiner.

Solvent Deasphalting Processes

The oldest deasphalting process is distillation. Unfortunately the very heavy lubricating oil fractions cannot be distilled commercially without decomposition even when the most modern equipment is employed. The loss of oil to still residue is, therefore, appreciable. Some of the asphaltic materials may also be carried over by the distillate. This can hardly be avoided because to secure the maximum possible vacuum the still should contain as few plates as possible and its construction should be very simple to avoid an excessive pressure drop which interferes with vaporization. It is also not yet definitely established whether no interference exists between the boiling points of the oil and asphaltic substances. However, for all practical purposes it may be assumed that a sharp separation between these two crude oil components cannot be achieved by plant distillation. Nevertheless if the recovery of extremely heavy oil fractions is of secondary importance, distillation might still be more economical than solvent deasphalting.

Sulfuric acid and clay are other conventional deasphalting agents. Because of its very versatile action sulfuric acid might remove from the crude oil some of its valuable fractions and this is particularly true if a thorough removal of asphaltic substances is desired. Besides the deasphalting action of the acid is seldom complete unless excessive quantities of the acid are employed. Clay is even less satisfactory than sulfuric acid in this respect and the quantity of it that is required to remove asphalt from an average type of crude lubricating oil becomes prohibitive.

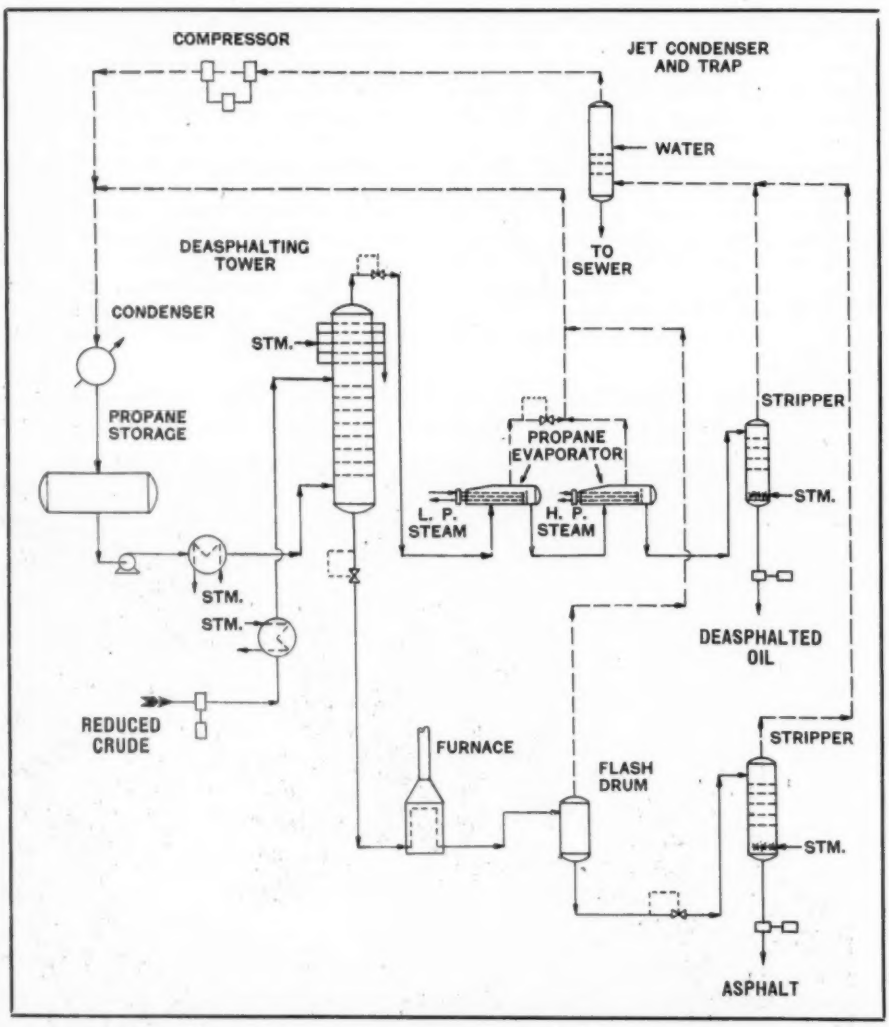
Ability of light hydrocarbon solvents to precipitate asphalt has been known for many years but the range in investigations has not been extended to the liquefied hydrocarbon gases until about 1920.[5] These low molecular weight substances were found to be very efficient in separating crude lubricating oils into fractions according to their molecular sizes. The difference between propane and similar hydrocarbons like methane, ethane, or butane, is not in their ability to act as precipitants but in the range of molecular sizes covered. Propane happens to best fit refinery requirements. If methane or ethane are employed some of the valuable heavy lubricating oil molecules are lost with the asphalt, while butane and higher members of this hydrocarbon series tend to keep a portion of the asphalt in the refined phase.

It is possible to use proper mixtures of hydrocarbon gases which would give results similar to those obtained with propane. However, such mixtures have a considerably higher vapor pressure than propane and their composition must be kept within close limits. Similar reasons including the cost of the reagents applies to the use of other low molecular weight substances recommended in some patents instead of propane.[6]

In commercial practice propane is often contaminated with other hydrocarbons including propylene. Such impurities should be kept at a minimum because they tend to disrupt the action of propane. Unfortunately no published data are available which would permit establishment of maximum practical limits for such contaminations. These limits will vary, however, with the individual plants because the unfavorable effect of impurities in propane might be neutralized to a certain extent by a change in the operating conditions. It is of interest that propylene is much less satisfactory than propane for deasphalting purposes although its molecular weight is slightly lower.

Originally propane was employed in a two-stage batch system. However, this method of applying it did not permit satisfactory separation of oil from asphalt and resulted in high losses of the refined oil. Counter-current extraction towers were consequently developed where the oil is allowed to gravitate downward from the top while propane is introduced at the bottom.

The propane-to-oil ratio is frequently as high as 9 to 1 in order to insure satisfactory separation of the asphalt and to reduce the quantity of oil lost in the asphaltic residue. A temperature gradient is normally maintained within the tower to insure maximum efficiency of extraction. The top and bottom temperatures vary somewhat in individual plants depending on the type of stock treated and degree of deas-



Flow diagram of propane deasphalting process

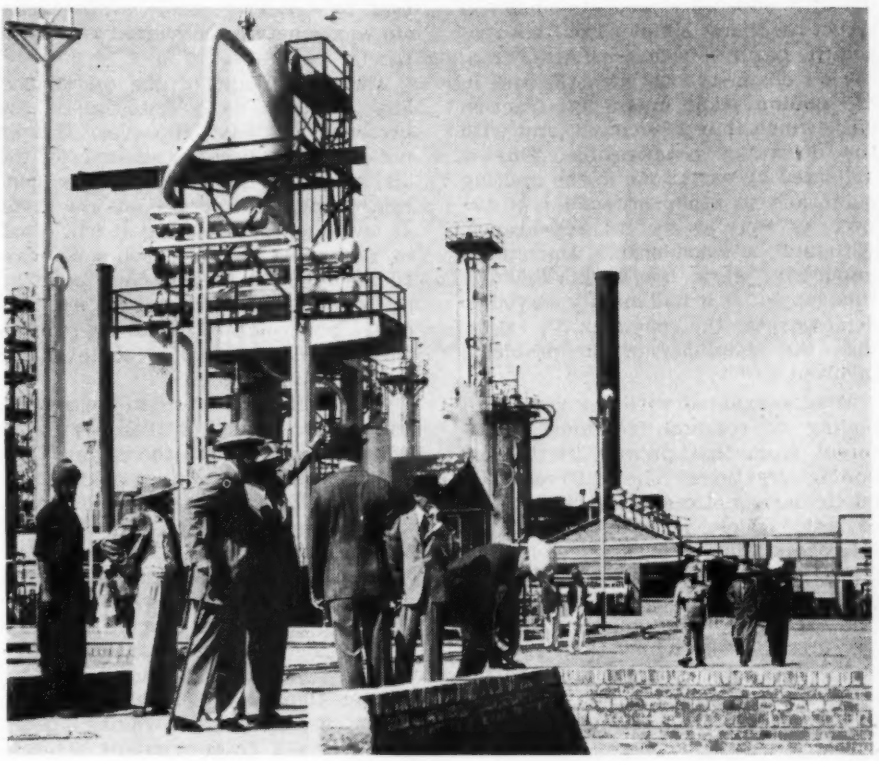
phalting desired. It is not uncommon to keep the top temperature at 180° F. and the bottom temperature at 120° F. Propane is often introduced at more than one point within the tower which facilitates maintenance of a proper temperature gradient within the system. No particular difficulty is encountered in pumping the precipitated asphalt which contains some dissolved propane that reduces its viscosty.

A general description of the solvent extraction technique is presented with the discussion of selective solvent processes and need not be repeated here. However, propane has some peculiarities of its own which are not observed with other commercial solvents and are related below.

Propane is a gas at normal temperatures but it can be liquefied by applying pressure. The maximum temperature at which propane may be compressed into a liquid is 212.2° F. The minimum pressure which must be applied at this temperature to keep it liquid is 643.3 psi. Above these critical conditions propane is a gas irrespective of the magnitude of the pressure used. This shows that by employing sufficient pressure the volume occupied by the gaseous propane at above 212.2° F. may be smaller than the volume of liquid propane below this temperature.

Liquid and gaseous propane differ in their solubility characteristics. Under certain conditions gaseous propane may dissolve more oil than liquid propane and within certain temperature ranges considerable variation in solubility is observed by merely varying the pressure at a constant temperature. This may best be visualized by describing the phenomenon known as retrograde condensation and observed with many mixtures near the critical temperature region.

Assume that the mixture consist of two components, A (oil) and B (propane). At a certain pressure B is dissolved by A while at a higher pressure A is dissolved by B. As the pressure is raised the homogeneous solution of B in A begins to separate into two phases because the component B begins to exert its solubility characteristics toward A. One phase consists, therefore, of a solution of B in A while the new phase is the solution of A in B. With further rise in pressure the solvent power of B toward A begins to outstrip the solvent power of A towards B until A is completely dissolved by B. Thus by merely raising the pressure a homogeneous solution begins to separate a second phase which first begins to grow and then diminishes with further increase in pressure until a homogeneous solution reappears again.



Vacuum lube oil distillation unit in Burmah, designed and constructed by the Lummus Co.

In a system consisting of propane, oil and asphalt (the last two terms are used qualitatively because of the impossibility of drawing a distinct dividing line between the two components for the reasons already explained) similar phenomena take place within certain temperature regions with the exception that the presence of the third component—asphalt—introduces additional complications. Propane tends to reject the asphalt while oil keeps it in colloidal solution. The propane-in-oil and oil-in-propane solutions that may exist under different pressures but at the same temperature behave somewhat differently towards the asphalt explaining the following observed behavior of such mixtures in certain temperature and pressure ranges.(7)

1. The higher the temperature, the less is the solubility of oil in propane.
2. The more propane is added to an asphaltic oil, the less asphalt is dissolved.
3. Pressure has a large effect on solubility.
4. Compressed propane gas will, at certain temperatures, dissolve more oil than liquid propane at slightly lower temperature and pressure.

In general, at temperatures of about 70° F. to 140° F. both oil and wax are quite soluble or miscible with propane while asphalt is not. At temperatures above 100° F. and up to its critical temperature, the solvent characteristics of liquid propane with respect to the oil begin to deteriorate. As the optimum treating conditions vary with the nature of the stock and the impurities which might be present in commercial propane, suitable adjustments are necessary in processing individual materials for securing the most economical results at various refineries.

Crystallization of Wax

On cooling, the wax separates from the oil. The structure of wax crystals is rather intricate and in most instances they form a complicated and interconnected network of solid material with a sufficient number of pockets to envelop all the oil which remains liquid. As a result, the whole body of the oil ceases to flow.

The ability of the oil to retain its fluidity at low temperatures is measured by the pour point, expressed in °F., and corresponds to the temperature at which the oil stops flowing when chilled under strictly specified experimental conditions. These conditions are very important because the method of handling the oil prior to the test, the rate of chilling and other variables affect the size and shape of the crystals, while the dimensions and design of the container and the method of taking observations have a direct effect on the stresses created within the network of the wax crystals and on its resistance to deformation. An oil which has stopped flowing from a small vessel may be fluid in a larger receptacle although the two are handled identically.

Wax present in the oil is not a

uniform substance and its chemical structure is not simple. For this reason the nature of wax separated from the oil changes both with the rise in the boiling point of the oil fraction with which it is associated, and with the dewaxing temperature. This is indicated by variations in the melting point and in other properties of the wax as well as by its appearance. Although a considerable amount of important work has been done on this subject[8] it has mainly served to demonstrate the complexity rather than the simplicity of the problems involved.

Wax associated with the very high boiling or residual fractions is different from that present in the low boiling fractions. The difference is particularly noticeable in the size of crystals which, in the case of the microcrystalline wax, are visible only under high magnification. The wax present in the residual oils is, therefore, referred to as microcrystalline or ceresin wax, while that present in the distillates is known as paraffin wax. As was previously mentioned, the split between the two types of waxes is usually achieved by distillation. However, the split is not necessarily sharp because waxes having a distinctly different crystal structure may overlap with respect to their boiling and melting points. Likewise, wax associated with the same boiling point oil fraction may be resolved in waxes of different melting points by varying the dewaxing temperature. To complicate the matter the presence of asphaltic substances in the oil may have a profound effect on the size of crystals formed. In the past, theories were even advanced that the difference between paraffin and ceresin waxes should be ascribed not to the variations in their chemical structure but to the presence of such impurities. It also seems possible that by cracking, some of the ceresin waxes may be converted into paraffin.

The pour point of the oil is usually accepted as a criterion of the presence of wax. However, this is not always so because viscosity of the oil itself, particularly when it contains asphalt, may become so great at low temperatures that it will cease to flow even in the absence of wax. In such instances the pour point of the oil is often referred to as "viscosity pour point". It can be reduced only by the removal of some of the asphaltic materials.

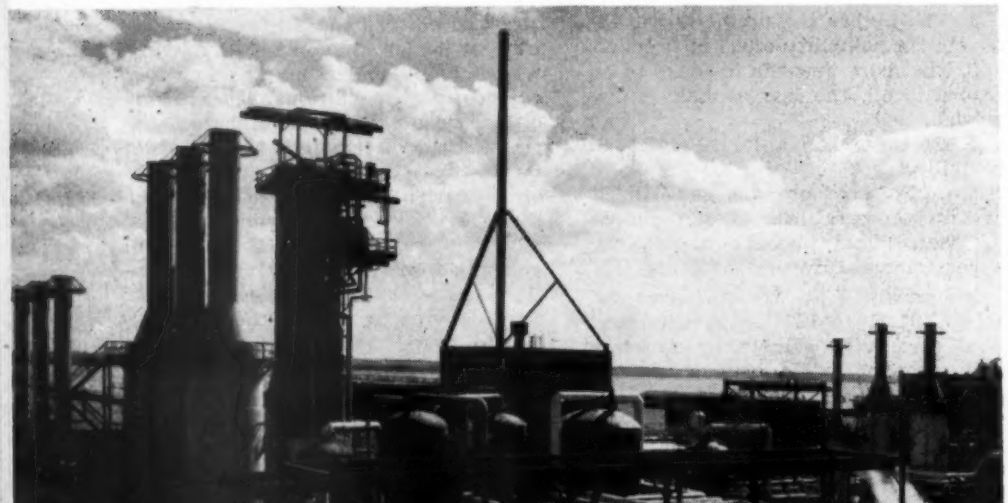
Crude oils differ both in the content and in the nature of their wax constituents. Some of them, such as Pennsylvania oils, may contain large quantities of waxes and pseudo-waxes while others, like Coastal oils, may be almost free of them. Likewise, one crude oil may contain relatively high melting point waxes while another one may be almost free of them although the absolute quantity of the wax present in the first oil may be greater than in the second. The behavior of the oil in dewaxing operations is to a certain extent dependent on these factors, while the traces of wax that are left in the finished oil may or may not be objectionable depending on their nature.

The high melting point waxes often precipitate at relatively high temperatures which may be considerably above the pour point of the oil. As a result, the oil acquires a cloudy appearance. The temperature at which such a cloud forms is referred to as the cloud point. A high cloud point has no significance with respect to oil performance but is usually objectionable to the customer. The wax cloud in a finished oil is often due to slight contamination with wax that has been reincorporated into the oil because of leaky filters or faulty dewaxing operations. It may also develop in products, such as those obtained from certain Coastal crudes, which are not dewaxed because of their low pour point though such crudes may contain traces of high melting point waxes. Before refining, these waxes are kept in solution by the asphaltic substances and low viscosity index constituents which prevent their precipitation. When such substances are removed in the course of refining the wax begins to precipitate at considerably higher temperatures because of the absence of these protective agents.

Similarly to the pour point, the cloud point of the oil depends on the conditions to which the oil is exposed. A finished oil may have a low cloud point as determined by the standard test but it may still develop a cloudy appearance after standing for several days or weeks at room temperature. Formation of such clouds can occasionally be prevented by the addition of substances such as beeswax or spermaceti[9], pentastearyl glucose[10], butyl borate[11] and others, though this is not always permissible because of the necessity of meeting other specifications, and the wax is removed by the usual dewaxing methods. It is of interest that the pour point depressants, i.e., substances which are capable of lowering the pour point of the oil by altering the structure of the wax crystals, are not very effective in lowering the cloud point.

The presence of moisture also imparts a cloudy appearance to the oil. It is not always possible to differentiate between the wax and moisture clouds by visual inspection, but this might be done by placing a drop of oil on a very hot plate and noting whether or not it sputters, which is indicative of the presence of water. The oil may absorb moisture not only in the course of processing but also in storage due to condensation of water vapors caused by temperature fluctuations. This can be avoided by equipping tanks with roof steam coils.[12]

View of Plant 14 at Sun Oil Co.'s Marcus Hook, Pa., refinery. At left are Petro-Chem furnaces and vacuum fractionating tower. Part of DuoSol extraction unit is in foreground



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"CLEARANCE POCKET" PISTONS

Reduce Compressor Installation Costs And Increase Gas Pumping Capacity In Natural Gas and Gasoline Plants

A NEW gas compressor piston, incorporating clearance pockets within the piston itself, has been developed for use in the natural gasoline and gas pipeline industries by Phillips Petroleum Co. engineers.

It was designed to solve the economic problem of sizing compressor cylinders to best take advantage of available or anticipated changes in operating pressure conditions. It will enable compressors to handle the wide variations in suction pressures usually met during the years a natural gas field is in operation without wasting available installed horsepower in the later period of decline in suction pressure.

Large savings to plant operators are said to have resulted from installation of the new design of piston instead of utilizing cylinder capacity greater than would be needed in the later operating period of the property. One particular installation saved an operator about $90,000, it was reported. The pistons are being made by one compressor manufacturer under license from the Phillips company. A number of shops have been licensed to manufacture them locally for replacement purposes.

The new piston was described in a paper, "Reduction of Installation Cost and Increased Gas Pumping Capacity by Use of Compressor Cylinder Clearance," by W. R. Barrett, superintendent, mechanical maintenance section, gas department, Phillips Petroleum Co., Bartlesville, Okla., and presented before the regional meeting of the Natural Gasoline Association of America in Amarillo, Texas, Dec. 10, 1948.

Adaptable to Hollow Pistons

Essentially the device is a compressor piston which incorporates internal clearance pockets and which is readily adaptable to any compressor cylinder having a cored or hollow piston, or whose piston is large enough to allow space for such pockets. A typical design is illustrated in Fig. 1.

The area inside the piston is divided by appropriate partitions into separate pockets of size and number deemed most suitable for the particular size cylinder involved. Part of the pockets may be opened to serve as additional clearance for the head end of the cylinder, and part may be opened for the crank end as desired. Clearance arrangement may be changed at any time by simply removing or replacing the plugs. This can be accomplished by taking off a valve and without removal of the cylinder head.

In the natural gasoline industry, it is seldom necessary or desirable to make changes in compressor cylinder efficiency more often than each three to six months. In most cases a change once a year will suffice. The oil and gas producer will usually arrange his production schedule so as

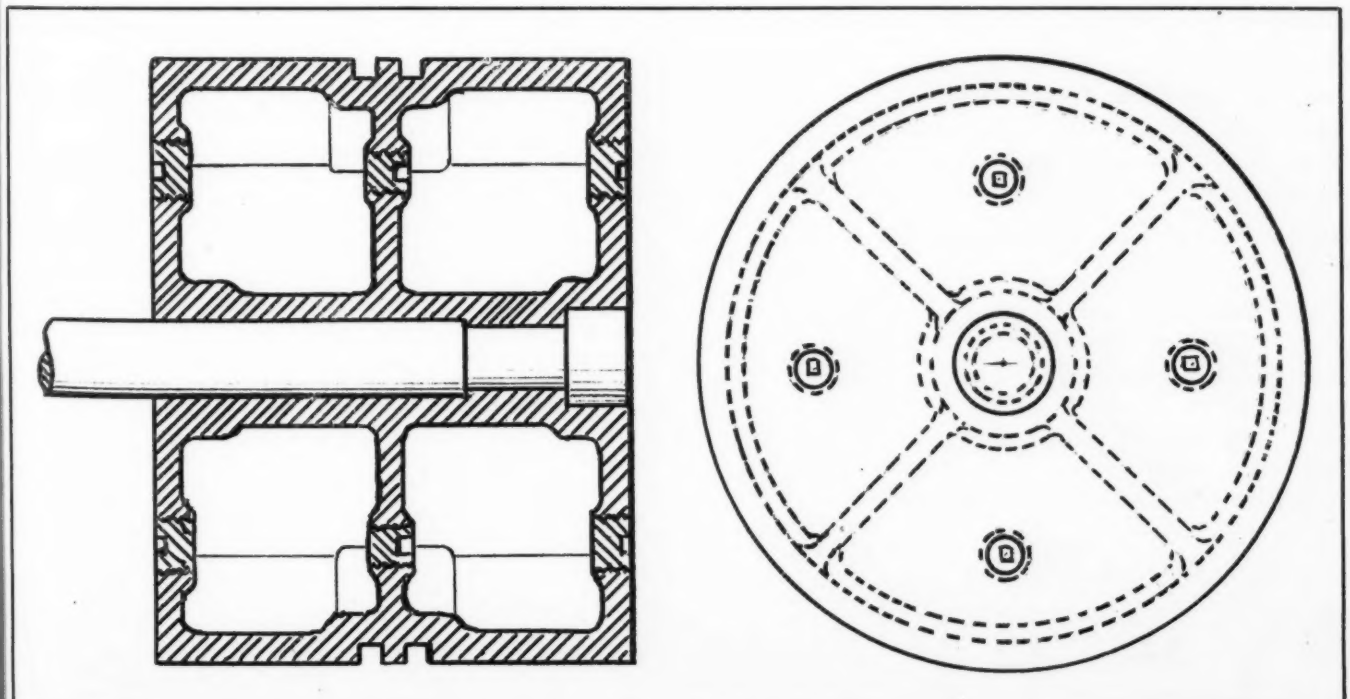

Fig. 1—Typical clearance pocket-type piston using eight pockets, in which clearance can be added in increments of 12½%

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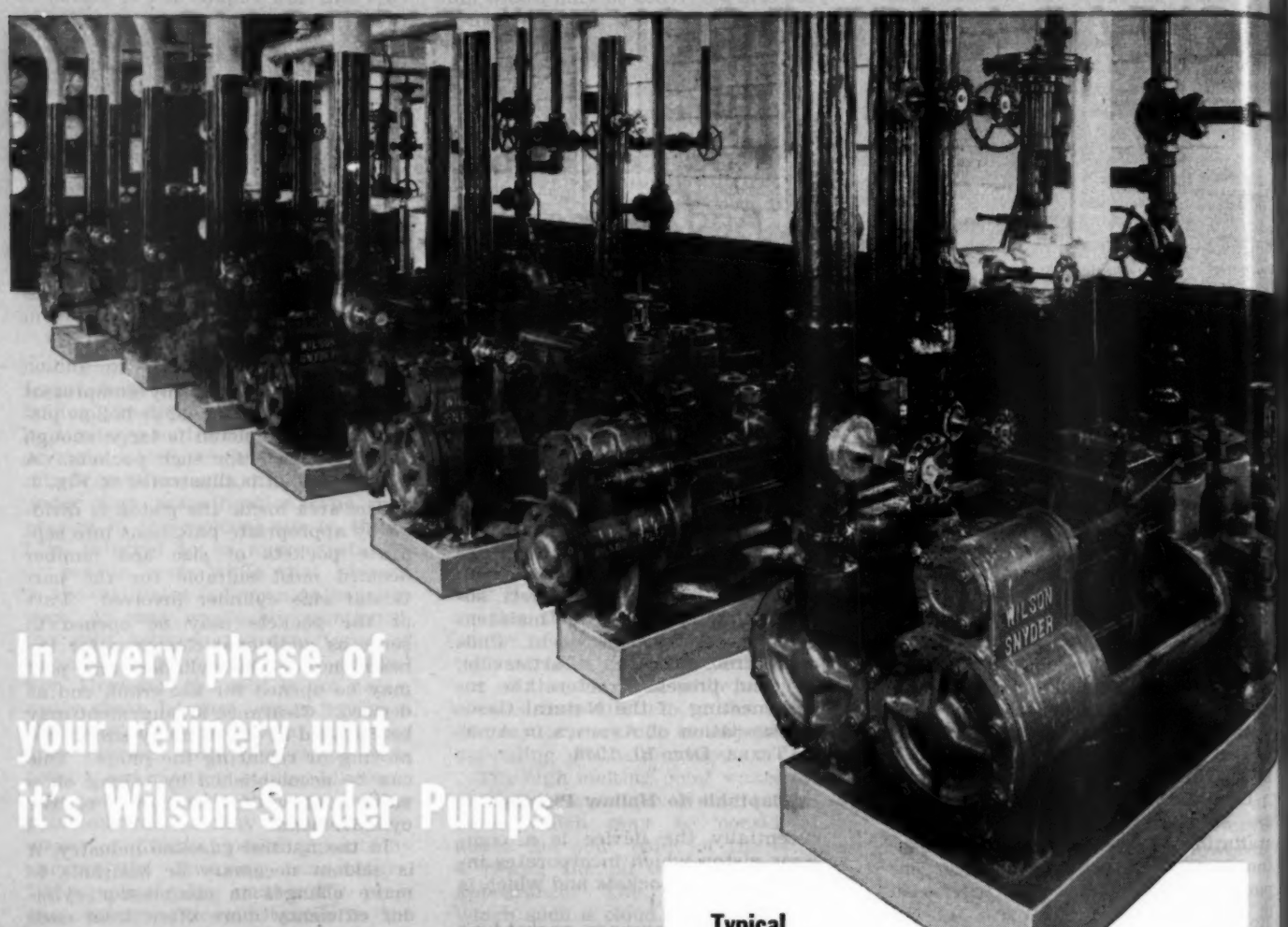

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1 — 5¼ x 16 Duplex Forged Steel Charge Pump—Diesel Engine Drive.
1 — 4 x 12 Duplex Forged Steel Charge Pump — Diesel Engine Drive.
1 — 10 x 6 x 10 Stabilizer Reboiler Pump.
1 — 10 x 6 x 10 Duplex Fractionator Charge Pump.
1 — 7 x 4½ x 10 Duplex Absorber Draw-off Pump.
1 — 10 x 6 x 10 Duplex Reflux Pump.
1 — 10 x 5 x 10 Duplex Spare Reflux Pump.
1 — 10 x 5 x 10 Duplex Stabilizer Charge Pump.
1 — 7 x 5 x 12 Simplex Stabilizer Reflux Pump.
2 — 6 x 4 x 6 Duplex Fuel Oil Pumps.
2 — 6 x 4 x 6 Duplex Boiler Feed Pumps.
1 — 6 x 4 x 6 Duplex Caustic Pump.
1 — 12 x 2 x 12 Simplex Ram and Test Pump.

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TABLE 1—Volumes and Effect of Internal Chambers in Compressor Pistons

Compressor			Piston			% Clearance		Volumetric Efficiency†		Reduced Size, Cylinder Using Internal Clearance
Size, ins.	Make	Type	No. of pockets	Cu. in. vol. of one pock.	Total int. clear. added cu. in.	Norm.	Max.	Norm.	Reduced	
—1—	—2—	—3—	—4—	—5—	—6—	—7—		—8—		—9—
10 x 20	Clark	VR	4	71.5	286.	7.04	16.5	82.9	64.25	9 x 20
10 x 20	Clark	S	8	51.4	411.2	6.1	19.5	84.7	58.25	8½ x 20
12 x 20	Clark	S	8	85.25	682.	4.6	19.95	87.9	57.30	10 x 20
14 x 20	Clark	S	8	140.	1120.	5.85	24.05	85.5	49.50	10½ x 20
16 x 20	Clark	S	8	185.	1480.	4.58	22.98	87.8	51.20	12¾ x 20
17 x 20	Clark	S	8	215.	1720.	4.17	23.3	88.7	50.70	14 x 20
18 x 20	Clark	S	8	245.	1960.	3.87	22.39	89.1	49.70	14 x 20
20 x 20	Clark	S	10	254.6	2546.	4.96	25.39	87.1	46.30	15 x 20
20 x 14	Clark	VTH	8	166.4	1331.2	7.22	22.45	82.5	52.40	16½ x 20
23 x 14	Clark	VTH	8	278.	2224.	6.4	25.65	84.1	45.80	18 x 14
26½ x 20	Clark	S	8	535.	4380.	4.27	23.97	88.6	49.50	20 x 20
27½ x 20	Clark	S	8	587.	4696.	4.00	23.77	89.1	50.00	22 x 20
12 x 16	I-R*	XRB	4	81.5	326.	7.0	16.25	83.0	64.70	10 x 16
16 x 16	I-R	XB	5	140.	700.	6.0	17.08	84.9	63.10	14 x 16
14 x 12	I-R	XVG	8	127.	1016.	10.0	37.4	76.8	22.00	7¾ x 12

* I-R is Ingersoll-Rand.
† Assuming that compression ratio is 4, and gas "N" value is 1.26.

to maintain a fairly constant volume over six month to one year periods. Or if the gas is being taken from dry wells, clearance changes are necessary only to take care of well pressure decline. This will usually not occur at less than six month intervals.

The clearance pocket type pistons may be installed in a cylinder at a cost slightly greater than that of conventional pistons, Mr. Barrett said. This represents only a small fraction of the cost of changing cylinders, is considerably less than that of any type adjustable pocket of comparable capacity and even cheaper than the conventional "bottle" type fixed clearance pocket of equal capacity.

An operator has the added advantage that the clearance is inside the cylinder out of the way, and volumetric efficiency may be changed at any time by one or two men in a few minutes. No maintenance cost is involved. The clearance when used is practically 100% effective; that is, the reduction in volumetric efficiency will be almost exactly the expected or calculated amount.

Conventional Pockets not Adequate

Usually, where other conventional clearance pockets are used, the added clearance volume is not fully effective and it is difficult to calculate with any great degree of accuracy the amount of clearance needed, Mr. Barrett pointed out. Piston pockets are more effective because the plug opening is on the flat area of the piston: as a result gas enters from all directions. The passage is of ample capacity, and short, and the pressure drop is negligible.

In the case of a pocket installed on the side of the cylinder, there is a long passage through both the cylinder wall and the water jacket. The gas from the entire area of the piston therefore must travel to one side of the cylinder. In addition, the passage becomes obstructed near the end of the stroke by the piston itself.

A pocket installed in the outer head has the advantage of being out in the center, the gas entering from all directions; and flow is not restricted by the piston. However, there is still a long passage through the water jacket, and the fact that clearance is applied only to one end of the cylinder results in an unbalanced condition leading to excessive vibration.

The problem of sizing cylinders to meet changes in operating pressure conditions has always been an important one in the natural gasoline and gas pipe line industries, Mr. Barrett said. "In practically every instance where a new field has been developed, and to a great extent where new installations have been made in an old field, the designer of the compressor plant has been confronted with the initial problem of comparatively large gas volumes, obtainable under relatively high suction pressures; whereas, he must anticipate that eventually the gas will have to be taken at atmospheric pressure or below."

Installation can be justified only for that equipment which it is reasonable to assume will be loaded throughout the period needed to retire the investment, he explained. This results in large volumes of gas being vented to the air in the early stages of operation and serious damage to compressor equipment, which is overloaded in an effort to handle as much gas as possible. Later, it is impossible to utilize the available installed horsepower due to decline in suction pressure. The result is the same, whether the decline is due to the producers demanding lower pressure or to extended gathering system and excessive pressure drop.

Saves Nearly $90,000

The installation in which the Phillips-designed clearance pocket type pistons saved a plant operator some $90,000 was a case where the gas volume and intake pressure had increased shortly after the plant was started up. The equipment comprised a battery of 35 250-hp., twin horizontal, gas engine compressors using 17 x 20 in. (Clark type "S") cylinders which the company had on hand. Design specifications actually called for cylinders of 14-in. bore. As a result of using the larger cylinders, the compressors were seriously overloaded in an effort to avoid wasting gas.

Equipping the plant with 70 new cylinders of the smaller size would have cost in the neighborhood of $90,000 to $100,000. Another alternative, adding more compressor units would have cost considerably more. Instead, the Phillips-designed pistons were used at a cost of $11,000. Operating conditions were satisfied by using only 62½% of the clearance available in these pistons. The gas pumping capacity was raised from the calculated 87,500 MCF/day to about 107,500 MCF/day, and the horsepower requirements were reduced to well within the rating for the units.

Installed in Booster Plant

In citing another case involving the use of the new pocket-type pistons, Mr. Barrett said:

". . . a booster compressor plant was planned involving installation of five 600-h.p. (Clark) right angle compressors. It was impossible to determine what the intake and discharge pressures would be. It was anticipated that for the first year or two gas might be received at suction pressures around 20 to 30 psig., and discharge pressure would depend to a large extent upon volume handled and discharge line pressure drop. It was generally agreed that the suction pressure would eventually be reduced to 0 psig., at which time 20-in. bore, compressor cylinders would be needed. It was finally decided that 14-in. bore cylinders would be the best guess for initial operation.

"The cost of 14-in. cylinders, including piping changes, later was estimated at $60,000. It was also anticipated that there probably would be no market for the cylinders when taken out of service.

"By using clearance pocket type

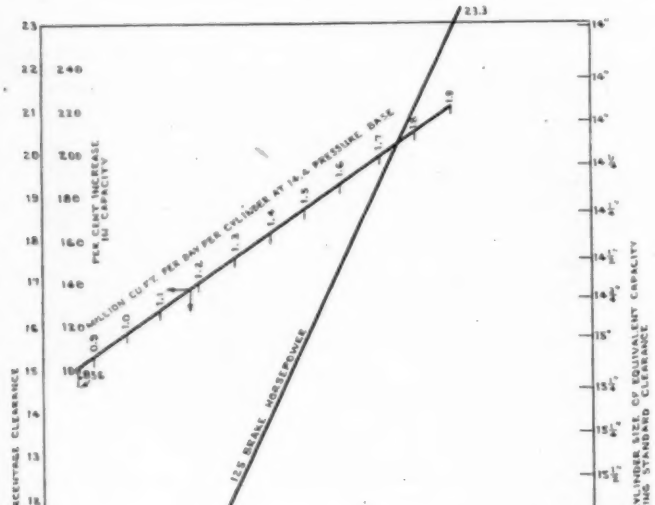

PERCENTAGE CLEARANCE
PER CENT INCREASE IN CAPACITY
MILLION CU FT PER DAY PER CYLINDER AT 14.4 PRESSURE BASE
125 BRAKE HORSEPOWER
APPROXIMATE CYLINDER SIZE OF EQUIVALENT CAPACITY USING STANDARD CLEARANCE
SUCTION PRESSURE, GAGE
VAC
POUNDS

Fig. 2—Results obtainable when a Phillips piston is installed in a 23 x 14 in. Type "VTH" Clark cylinder with operating conditions as indicated

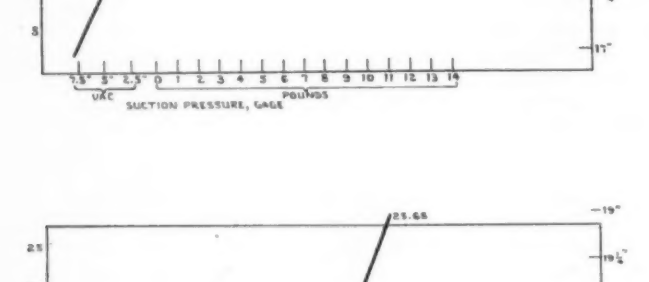

PERCENTAGE CLEARANCE
PER CENT INCREASE IN CAPACITY
MILLION CU FT PER DAY PER CYLINDER AT 14.4 PRESSURE BASE
100 B.H.P.
APPROXIMATE CYLINDER SIZE OF EQUIVALENT CAPACITY USING STANDARD CLEARANCE
SUCTION PRESSURE, GAGE
VAC
POUNDS

Fig. 3—Results obtainable when a Phillips piston is installed in a 17 x 20 in. Type "S" Clark cylinder with operating conditions as indicated

pistons in 20-in. cylinders with 60 psig. discharge pressure, intake pressure up to and including 8 psig. could be handled without exceeding the capacity of the power end.

"It later developed that gas could be obtained at higher pressure than 8 psig. By unloading the crankcase end of each compressor cylinder and using maximum available clearance on the head end, suction pressure up to 45 psig. and discharge pressure of 80 psig. were handled. Thus a maximum volume of 72 million cu. ft. per day was pumped, whereas the original estimate had been 54 million cu. ft./day.

"Tests on the unloaded crankcase end of compressor cylinders revealed a loss of 8 brake hp. per cylinder, or 32 bhp. per unit. While unloading of cylinders by removal of suction valves was resorted to in this case, results could not be duplicated without the clearance type piston. The load is distributed equally to all cylinders, and as suction pressure declines equal distribution can be maintained by closing the clearance pistons until all pockets have been plugged. At that time all pockets will be opened up again and the crankcase end of the cylinders loaded up. As further decline occurs, pockets will again be plugged as necessary to keep the engine fully loaded."

Mr. Barrett pointed out that in both cases an important feature is that as the suction pressure declines, the clearance arrangement can be changed gradually to take full advantage of available suction pressure and keep the power end fully loaded at all times. This cannot be accomplished by any other known method except at a great deal of expense, he added.

"In a number of cases recently, specifications called for 14-in. diameter cylinders, and 17-in. cylinders with clearance pocket type pistons were used. In these cases the 17-in. cylinders were on hand whereas the 14-in. would have had to be purchased new. In all cases calling for purchase of new cylinders, the specifications were changed to use the largest size it is anticipated will be eventually needed and they were equipped with clearance pocket pistons."

Illustrates Flexibility

The flexibility of compressor cylinders using the special pistons is graphically illustrated in Table 1 and Figs. 2, 3, 4, and 5. Table 1 comprises a list of compressor cylinders to which the clearance pocket type pistons have been applied. Column 4 shows the total number of pockets in each piston; column 5 shows the volume in each pocket; column 6 shows the total volume in all the pockets (this would be divided between the head and crankcase ends in opera-

tion). Column 7 is a comparison of normal percent clearance with maximum percent clearance (all pockets open). Column 8 compares volumetric efficiency using normal clearance with volumetric efficiency using maximum available clearance (all pockets open), and presents it in terms of percent of overall piston displacement. Column 9 shows the nominal cylinder size having normal factory clearance to which the capacity of the cylinders in Column 1 may be reduced by using all the clearance available in the special pistons.

The values in Columns 7 and 8 are on an overall basis. There would of course be a slight difference between the head and crankcase ends because of the rod displacement. In calculating the values in Columns 8 and 9, a compression ratio of 4 and a gas "N" value of 1.26 were assumed.

Fig. 2 represents results obtainable with a 23 x 14 in., Type VTH Clark compressor cylinder continuously loaded to 200 bhp., as would be the case on an 800 hp., right angle Clark compressor. With 60 psig. discharge, the suction pressure may be varied from 7½ in. Hg. vacuum to 10½ psig. inclusive, and the capacity of the 23-in. cylinder reduced to the equivalent of a 19-in. cylinder using standard clearance.

Fig. 3 represents results obtainable with a 17 x 20 in. Type "S" Clark compressor cylinder continuously loaded to 125 bhp., as would be used on a 250 hp., twin, horizontal Clark compressor. With 70 psig. discharge, the suction pressure may be varied from 7½ in. Hg. vacuum to 14½ psig. inclusive, and the capacity of the cylinder reduced to the equivalent of a 14-in. cylinder using standard clearance.

Fig. 4 represents the results obtainable with a 20 x 14 in., Type "VTH" Clark compressor cylinder, loaded to 150 bhp. per cylinder as would be the case on a 600 hp., right angle compressor. With 60 psig. discharge, suction pressure can be varied from 7½ in. Hg. vacuum to 8 psig. inclusive, and capacity may be reduced to the equivalent of a 16¾-in. cylinder using standard clearance.

Fig. 5 represents results obtainable with a 20 x 20 in., Type "S" Clark compressor cylinder continuously loaded to 125 bhp. as would be used on a 250 hp., horizontal twin Clark. With 45 psig. discharge pressure, the suction pressure may be varied from 12.5 in. Hg. vacuum to 8 psig., and the capacity of the cylinder reduced to the equivalent of a 16¾-in. cylinder using standard clearance.

Clark Bros. Co. is manufacturing these pistons at present under license from Phillips. The following shops are licensed to manufacture them locally for replacement purposes: Midwest Machine Co., Baash Ross Tool Co., Eureka Tool Co.

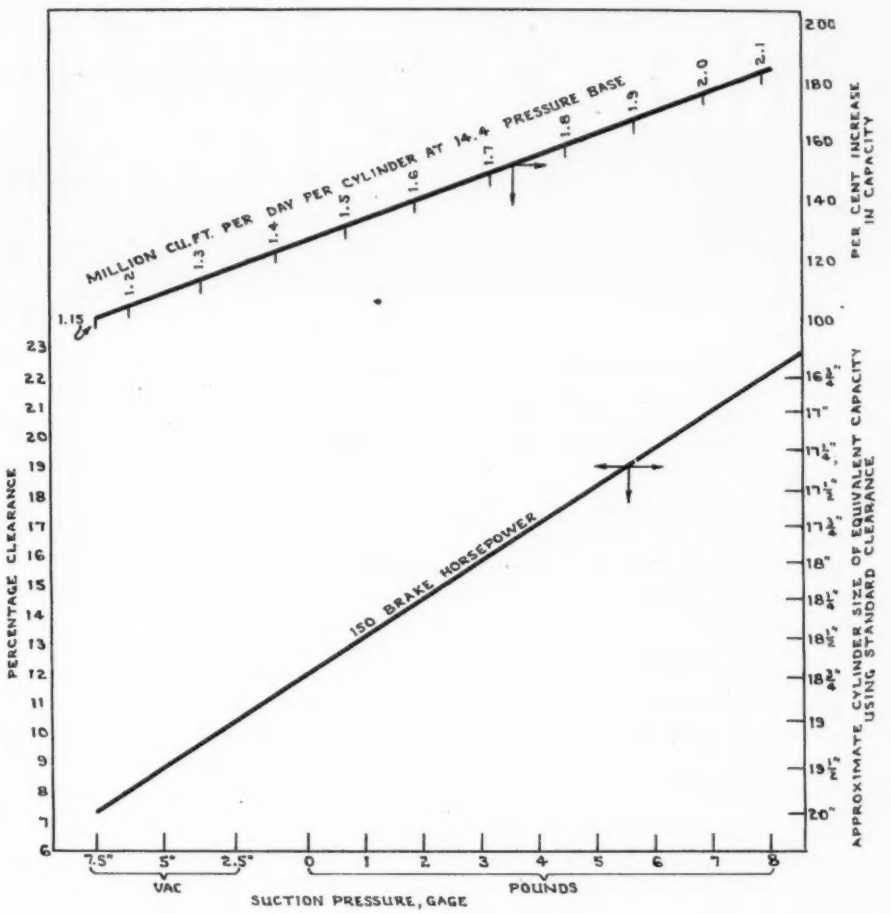

MILLION CU.FT. PER DAY PER CYLINDER AT 14.4 PRESSURE BASE
150 BRAKE HORSEPOWER
PERCENTAGE CLEARANCE
PER CENT INCREASE IN CAPACITY
APPROXIMATE CYLINDER SIZE OF EQUIVALENT CAPACITY USING STANDARD CLEARANCE
SUCTION PRESSURE, GAGE
VAC
POUNDS

Fig. 4—Results obtainable when a Phillips-type piston is installed in a 20 x 14 in. Type "VTH" Clark compressor cylinder with operating conditions as indicated

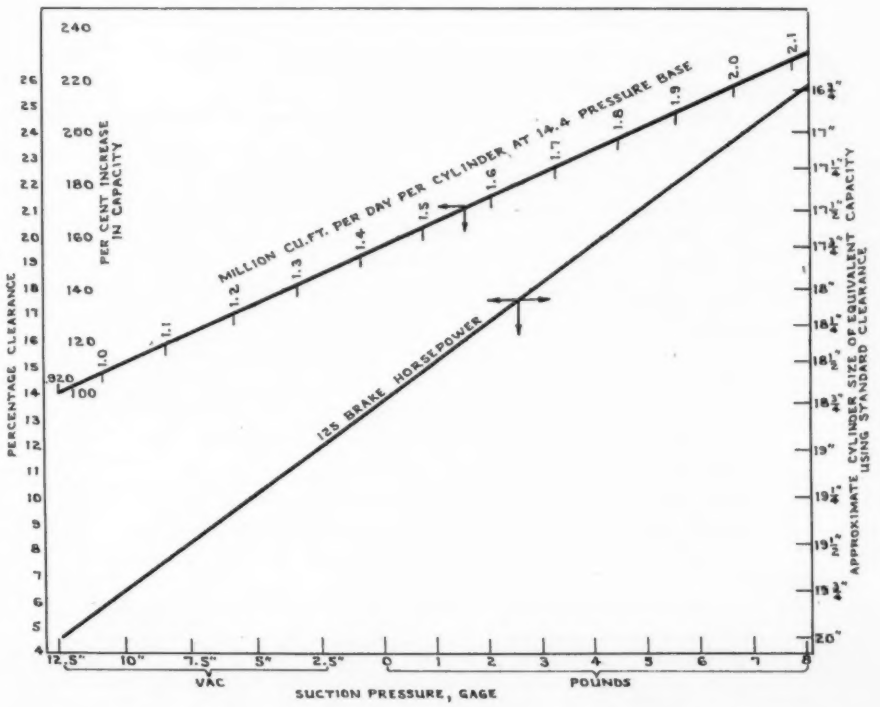

MILLION CU.FT. PER DAY PER CYLINDER AT 14.4 PRESSURE BASE
125 BRAKE HORSEPOWER
PERCENTAGE CLEARANCE
PER CENT INCREASE IN CAPACITY
APPROXIMATE CYLINDER SIZE OF EQUIVALENT CAPACITY USING STANDARD CLEARANCE
SUCTION PRESSURE, GAGE
VAC
POUNDS

Fig. 5—Results obtainable when a Phillips piston is installed in a 20 x 20 in. Type "S" Clark cylinder with operating conditions as indicated

HERE'S MONEY SAVING NEWS

for Compressor Plant Operators and Designers

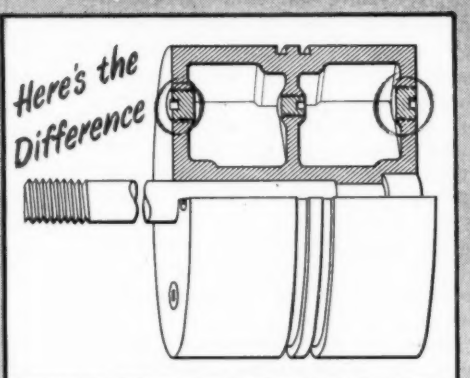
Most economical method of changing the volumetric efficiency of your reciprocating compressors

$ How would you like to save $79,000?

The simple new clearance pocket compressor piston has already done that in one gasoline plant. Here's how it happened. Thirty-five 250 HP twin compressors were in use with 17" x 20" Clark type "S" cylinders. Increasing operating pressure would formerly have required the installation of replacement compressor cylinders at a cost of $90,000 to $100,000. Installation of the new clearance pocket pistons gave the desired operating results at a cost of only $11,000 — *a clear saving of at least $79,000!*

The installation of these new clearance pocket pistons provides you with ten worthwhile advantages whether your anticipated operating pressure is *higher* or *lower* than at present:

1. **Allows you to install compressor cylinders of maximum displacement to take your gas at the lowest anticipated suction pressure.**
2. **Allows you to utilize your present cylinders and reclaim your old cylinders which have no provision for added clearance.**
3. **Allows you to change your volumetric efficiency over an exceptionally wide range.**
4. **Allows you to keep your power end fully loaded at all times.**
5. **The clearance pockets require no maintenance.**
6. **Permits easy, rapid changing of cylinder clearance by changing plugs through valve ports. Time required — only a few minutes.**
7. **The variable clearance is *inside* the cylinder, not external.**
8. **Added clearance is practically 100 percent effective.**
9. **Added clearance is in both head and crank ends of your cylinder. No vibration is induced by uneven pumping load.**
10. **Best of all, these advantages are yours at a small fraction of the cost of changing cylinders or adding compressors.**



Sketch shows cutaway clearance pocket piston. Note the main central web dividing the piston interior into two chambers. Each of these main chambers is subdivided into four pockets. Opening or closing these with plugs in piston heads varies compressor cylinder volumetric efficiency. Clearance pockets are ideally located for efficient loading and unloading.

Clearance pocket pistons are available with new cylinders or as replacement pistons from:

Clark Brothers Company
Olean, New York

The following shops are licensed to manufacture the pistons locally. They can furnish clearance pocket pistons to fit any cylinder of any make, size or type in which the piston is large enough to accommodate the pockets.

Baash Ross Tool Company — Pampa, Texas, and Los Angeles, Calif.
Oklahoma City, Okla., and Houston, Texas

Midwest Machine Company — Oklahoma City, Okla., and Odessa, Texas

Eureka Tool Company — Oklahoma City, Okla.

Phillips 66

For additional information address:

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BARTLESVILLE, OKLAHOMA

An Expanding Market—

Antifreezes from Petroleum

By B. H. WEIL
Chief, State Engineering Experiment Station
Georgia School of Technology, Atlanta

Properties and characteristics required of antifreeze compounds are analyzed, and it is shown how alcohols meet these requirements. The manufacture from petroleum and other sources of methanol, ethanol, isopropanol, and ethylene gycol are reviewed briefly. Oil companies, now believed to be distributing around 35,000,000 gallons of the total of 70,000,000 gallons of antifreeze consumed annually, are showing greater interest in the manufacture of alcohols used in these compounds.

A FEW petroleum companies have for some time been manufacturing all or some of the commonly used antifreezes, which are actually chemicals from petroleum, and many more companies lately have been studying their sales of this material with the question in mind as to whether it would pay them to make their own.

Any answer to this question must be tempered by specific circumstances, but all answers must be based on the "facts of life" of antifreeze compounds: (1) the requirements for a good antifreeze, (2) the degree to which these are met by currently popular antifreezes, (3) present methods of making all those antifreezes which are producible from petroleum hydrocarbons and (4) the economics of antifreeze production; prices, producers, production, consumption trends, etc.

The choice of antifreezes for cooling systems of internal combustion engines is limited by technical as well as economic factors. According to the Maintenance Methods Co-ordinating Committee of the Society of Automotive Engineers, a good antifreeze must have the following qualifications:

(1) Ability to lower the freezing point of water to the lowest winter temperature likely to be encountered.

(2) Incapability of imparting any undesirable properties to the water which would interfere with its primary function of efficient engine cooling.

(3) Satisfactory chemical stability in service and the ability to protect cooling system metals from the corrosive action of the water.

Corollaries of the second requirement are: (4) ability to circulate freely at the lowest operating temperatures (ie., low viscosity) and (5) high heat capacity per unit volume. Other desirable characteristics include: (6) nonflammability, (7) low partial pressure, (8) low coefficient of expansion, (9) low foaming tendencies, (10) low creepage, (11) freedom from pronounced or objectionable odor, and (12) availability at a reasonable price.

The reasons for most of these requirements are self-evident and have been described in detail elswhere.(2, 5, 14) However, a brief discussion here will make the later comparison of specific materials more intelligible.

As regard freezing protection, it should be noted that the protective solutions have a freezing *range* rather than a freezing point and, when exposed to temperature conditions say 10° F. below their freezing points ice crystals form and the mixture becomes a slush, stiffening as the temperature is lowered but never becoming a crystalline solid.

However, "while it is true that this phenomenon practically eliminates the possibility of block breakage and jacket damage due to freezing alone modern practice does not consider that the system is protected, for stiff slushes cannot be circulated and, therefor, will not transfer heat as they should. This leads to local overheating and block breakage due to excessive heating."(14)

The freezing protection of solutions, therefore, extends somewhat below the temperature at which the first ice crystals appear but only to a protection point which varies with the nature of the antifreeze and its concentration. Table 1 presents one concrete example and Fig. 1 is a comparison of the freezing point curves for commonly used concentrations of popular antifreeze materials.

TABLE 1—Minimum Safe Temperatures of Typical Antifreeze Solutions(2)

Antifreeze	Freezing Point, °F.	Min. Safe Temp., °F.
Methanol	0	—2.5 to — 5.5
Ethanol	0	—5.5 to — 8.0
Ethylene glycol	0	—8.0 to —11.5

As noted in the above list of desirable characteristics, properties (4) and (5) are really phases of the second qualification—nonimpairment of the coolant properties of water. Such antifreezes as honey and glycerine solutions have viscosities many times that of water at temperatures above 32° F., and even 50% alcohol or glycol solutions are somewhat more viscous than water at these temperatures, although far less viscous than the others at temperatures below the freezing point of water.(5) The problem of high viscosity is one of the factors that eliminates from practical consideration such coolants as light motor oils and kerosene. While cooling systems could be designed for their use, these materials are too viscous for proper circulation in systems designed for the use of water.

Heat capacity per unit volume poses no problem with the popular antifreezes (alcohols and glycols). While "the specific heats of aqueous solutions, in general, decrease with increasing concentration at constant temperature and also decrease for a given concentration as the temperature is lowered (ethanol and methanol are exceptions) . . . heat capacity per unit volume is the product of specific heat and density, and, since the density of a given solution increases as the temperature is lowered . . . all the aqueous solutions under consideration prove to be relatively satisfactory as regards heat capacity."(2)

The desirability of a low coefficient of expansion is one phase of the campaign to minimize loss of antifreeze solutions through the overflow pipe. All antifreeze solutions expand at a greater rate than water. Solutions protected to 0° F., for example, undergo the following thermal expansions (in pints per gallon of liquid) on heating from 40° to 180° F.: ethylene glycol, 0.34; methanol, 0.37; ethanol, 0.47, as compared with water, 0.24.(2)

"Considerable controversy has ex-

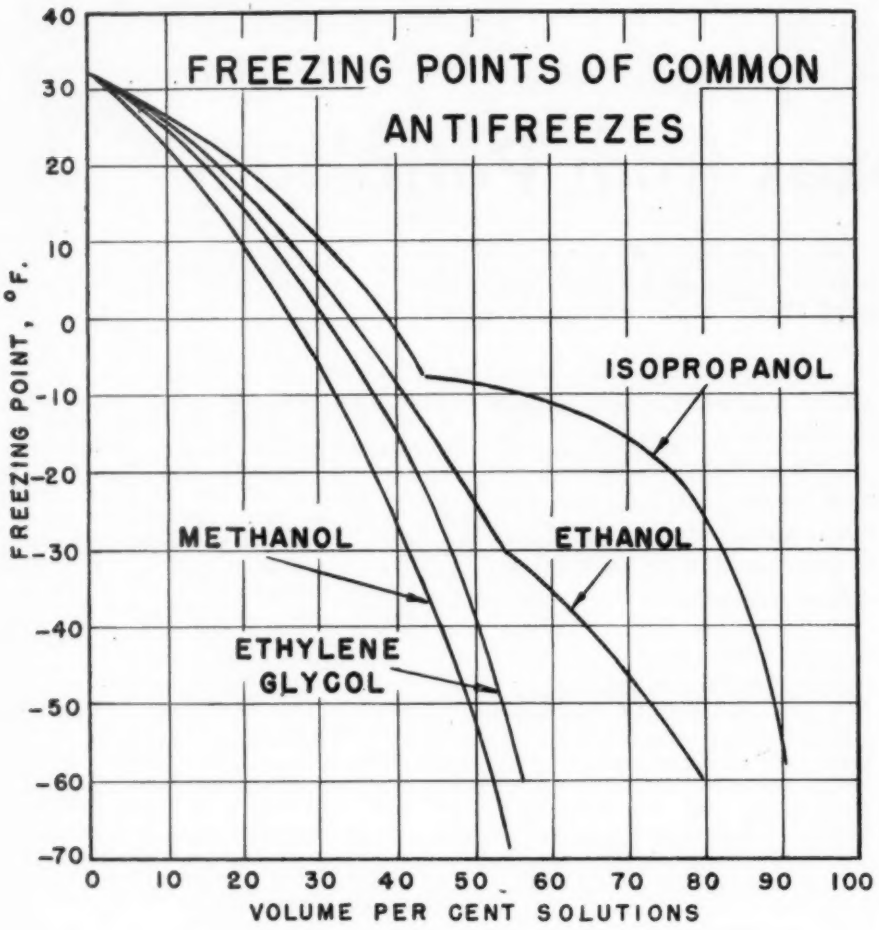


Fig. 1—Freezing points of Common antifreezes

isted in the past over the principal causes of antifreeze losses from cooling systems. Since the boiling points of the volatile type antifreezes are lower than for water, it was popularly assumed, that evaporation was the main cause of antifreeze loss. Tests have shown this assumption to be erroneous and have established that the main losses were of a mechanical nature. Losses due to evaporation in cooling systems in good repair appear to be very slight."(14)

The principal losses, according to this source, "are mechanical in nature and are due to leaks, thermal expansion, and losses through the overflow pipe due to surges of the liquid." Zink(14) cites Table 2 in support of this contention, pointing out that the boiling points of the commonly used concentrations of alcohol antifreezes are considerably higher than those of the pure compounds, hence that the fact that cooling system thermostats are usually set to operate at 140-160° F. is not as conducive to loss from boiling as is usually credited.

TABLE 2—Boiling Points of Alcohol Antifreezes(1)

Vol. % Alcohol	—Boiling Point, °F.— Ethanol Water	Methanol Water
10	199	198.7
20	190	191.2
30	183.2	186.8
40	177.6	185.4
50	173	181.3
60	168.7	179.2
70	164.7	177.5
80	160.4	175.8
90	155.7	174.0
100	148.3	173.2

The opposite view is commonly accepted, (2, 5,) however. According to one source,(2) "it should be pointed out that these (thermostat) opening temperatures represent only the minimum theoretical solution temperatures, since the rated wide-open thermostat temperature . . . vary from 170-185° F., and therefore, the actual liquid temperature in normal cooling systems will lie between the opening and wide-open temperatures. To the temperatures indicated above, upwards of 20° must be added for the normal temperature rise in the cooling liquid immediately after stopping the vehicle. If boiling and its attendant troubles are to be avoided, the maximum solution temperature reached after stopping the vehicle or engine must be below the boiling point of the solution." Table 3 is cited as a guide.

It is further pointed out that the boiling point of water and aqueous solutions is depressed 2° F. for each 1000-ft. rise in elevation, thereby increasing possibilities of boiling and overflow loss. "On the other hand, radiator-cap pressure valves in sealed cooling systems raise the boiling point of water and antifreeze solutions."

TABLE 3—Boiling Points of Commercial Antifreeze Solutions[3]

	Boiling Points of Aqueous Solutions Providing Freezing Protection at			
	10° F.	0° F.	—10° F.	—20° F.
Methanol type	190	185	182	179
Ethanol type	187	184	182	180
Ethylene glycol type	218	220	221	223

Chemical Stability

Water, under the conditions prevailing in automotive cooling systems, is itself corrosive to the metals present, and this tendency is increased by the presence of dissolved oxygen and carbon dioxide at the high temperatures prevailing. While the common antifreeze materials are usually less corrosive than water, it has become customary to add inhibitors to brand antifreezes to minimize corrosion when the solutions are used. Organic or inorganic salts and oils and fats are commonly employed, no one inhibitor having proved satisfactory as protection for all metals.

Additional inhibitors are employed with the non-volatile-type antifreezes, such as ethylene glycol, to minimize foaming (and consequent overflow losses), while others are added to minimize seeping or creeping. The latter is caused, in uninhibited antifreezes, by the tendency of antifreeze materials "to loosen rust and creep through rust-filled crevices in the cooling system which have previously been plugged leaktight when using only water."(2) This tendency is particularly true for the glycol type antifreezes and is especially serious for leaks into an engine's cylinders and crankcase, for lacquering of the cylinder walls follows in a short time, causing engine overheating and damage to cylinder walls and bearings. However, for well-inhibited glycol solutions, the leakage rate is lower than for water. Evaporation retarders are sometimes added to the volatile-type antifreezes to form a more or less continuous surface film.

No further discussion of good antifreeze qualifications seems necessary here. All the alcohols are flammable in concentrated form but are not particularly dangerous in the solutions commonly employed (less than 50% concentrations). Ethylene glycol presents no fire hazard, nor does glycerine. Careful handling of anti-

freezes is needed to prevent damage to the finish of cars.

POPULAR ANTIFREEZES

The popular, commonly used antifreeze materials are methanol, ethanol, and ethylene glycol, as shown in Fig. 2, which gives the trends in antifreeze consumption over the past 18 years.

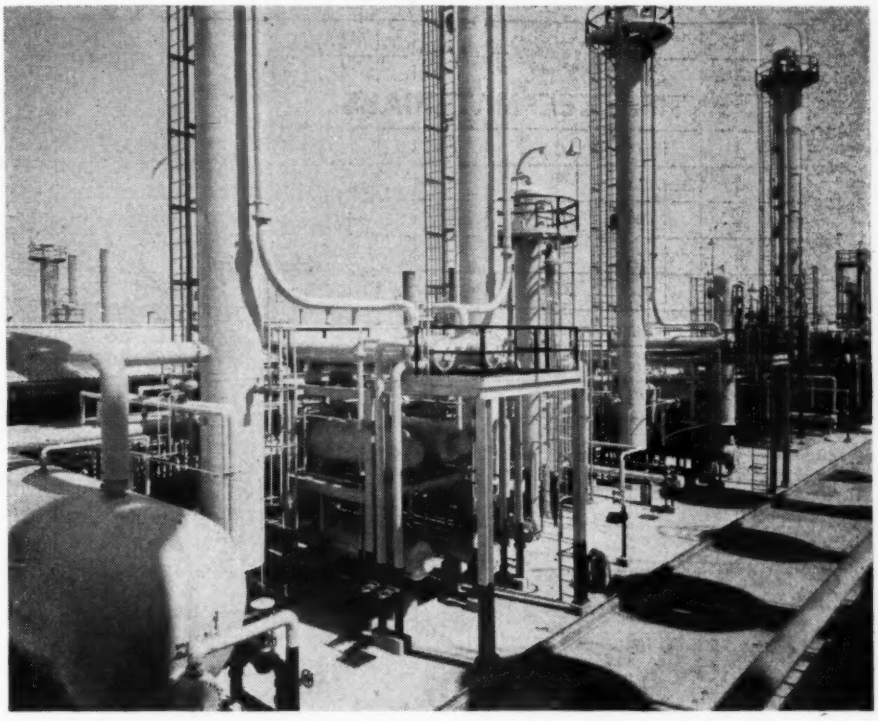
Fig. 1 indicates that, on an equal volume basis, the antifreezes rate in the following order in granting freezing protection: (1) methanol, (2) ethylene glycol, (3) ethanol, and (4) isopropanol. As shown by Table 1, however, ethylene glycol, ethanol, and methanol rate in that order in regard to maximum protection for solutions of equal freezing point. For such solutions, in addition, it has been previously mentioned that ethylene glycol, methanol, and ethanol rate in that order in thermal expansion.

Table 3 shows that ethylene glycol is the only one of the "big three" antifreezes that imparts increased boiling points to its solutions with increase in concentration. Regardless of the economic considerations concerned with boiling this is of significance in permitting engines to operate at higher, more efficient temperatures.

No further discussion of corrosion, foaming, and creepage seems pertinent here, since these tendencies may —and must—be inhibited by use of additives. In regard to corrosion, incidentally, tests[2] on properly inhibited antifreezes of the methanol, ethanol, and ethylene glycol types have shown that all three are less corrosive than inhibited water (to varying degrees in relation to specific metals).

It seems timely to mention, in passing, the existence and general disapproval as antifreezes of (1) inorganic salt solutions, (2) sugar and honey solutions, and (3) such coolants as kerosene and light lubricating oils. Electrical conductivity and corrosivity are the principal objections to the first group, along with the possibility of crystal formation in the radiator. "Sugar solutions (including honey and molasses) may become excessively viscous at low temperatures and cause inadequate circulation and overheating in the cooling system. Charring of sugars will seriously interfere with heat transfer from the engine, and charred deposits in the water jacket will present a most difficult cleaning problem."[2]

Kerosene and light lubricating oils have been used by themselves as coolants—they do not mix with water and hence cannot be used to lower its freezing point. Those composed primarily of highly refined aliphatic and naphthenic hydrocarbons (no aromatics or olefins) can be used when the radiator hose and other fixtures are made of suitably selected (oil resistant) synthetic rubbers; they do not creep, provide antifreeze protection to —40° F. or lower, do not corrode metals, and do not produce obnoxious fumes.



Alcohol plant of an oil company refinery in the southwest

Many petroleum distillates, however, do not meet these required qualifications, and few automobiles are equipped completely with the proper synthetic rubber connections, so that the deterioration of these parts frees residues which block radiator passages. Of equal or greater importance, as mentioned earlier, is the fact that "oils are not suitable as

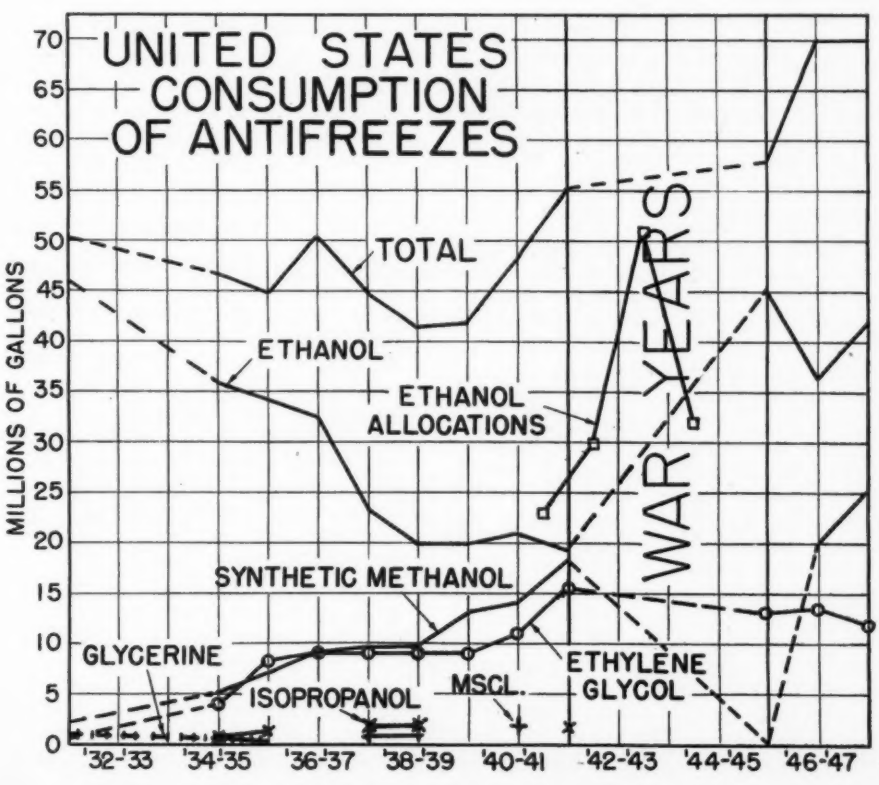


Fig. 2—U.S. Consumption of antifreezes

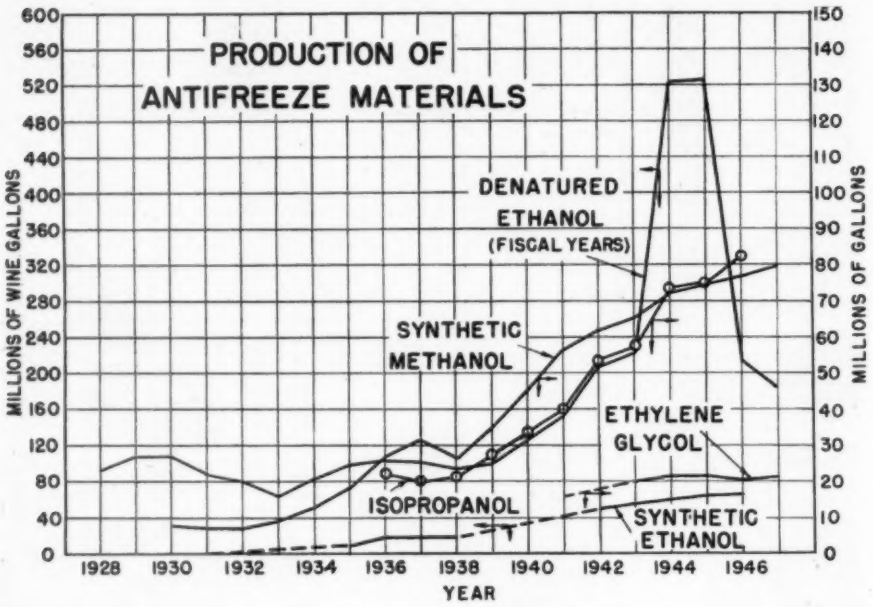


Fig. 3—Production of antifreeze materials

coolants in engines designed for water cooling, because of their low heat transfer properties, and, under heavy load or at high speeds, serious engine damage from overheating can result from their use. Since oil vapors are inflammable, a very real fire hazard is presented when boiling and overflow of the oil occurs with overheating of the engine."(2)

Little attention has been given here to glycerine, which, when properly inhibited, is a suitable antifreeze in solutions of 50% or lower concentrations, although considerably more viscous at low temperatures than the popular antifreezes; like ethylene glycol, it is a non-volatile-type material. Isopropanol is also a suitable antifreeze, although more is required, on a volumetric basis, to give the same protection granted by other common antifreeze materials.

Much mention is made in the literature of the toxicity of methanol vapors, and some consumer groups class such antifreezes as "definitely not recommended" for this reason.

During the 1947-48 season, the motorist, as in recent years, was left with little choice. Many of those who prefer the "permanent-type" (glycol) antifreezes were unable to obtain them, even though their customary price of $2.65 a gallon was a definite bargain when compared with prevailing prices of $1.75-$2.25 for volatile-type ethanol antifreezes. Methanol antifreezes were priced at their customary $1.00 per gallon level, although they were almost unobtainable, as mentioned. As pointed out by many, the increased number of automobiles on the road, lack of transportation facilities, and uncompleted production-increase programs all added to the difficulty occasioned by the strong demands for methanol and ethylene glycol for other uses.

It would seem, then, that on the basis of merit, economics aside, ethylene glycol and methanol are the antifreezes of most general interest, although attention must always be given to ethanol, isopropanol, and glycerine. Incidentally, propylene glycol is almost as acceptable an antifreeze as ethylene glycol, and it appears likely that mixtures of both glycols will be marketed in the near future.

PRODUCTION METHODS

The popular antifreezes are organic chemicals and, as such, may be produced in a number of ways from different raw materials. Following is a brief description of the methods of their synthesis.

Methanol

Methanol, CH_3OH, was once known as "wood alcohol" because it was produced by the destructive distillation of wood. It is now synthesized to a large extent by the catalytic reaction of carbon monoxide and hydrogen, at temperatures in the vicinity of 750° F. and at pressures ranging from 50-1,000 atmospheres. The high pressures required are what distinguish this synthesis from the Synthine process for the production of "synthetic petroleum."

Synthesis gas may be produced from the reaction of coke and steam (71% in 1946), but of more interest to the petroleum industry is, the well-known "methane-steam" reaction, using natural or refinery gases, or the partial oxidation of these latter materials. About 77% of the methanol produced this year from carbon monoxide and hydrogen will be derived from natural gas. Methanol itself is directly producible by partial oxidation of light hydrocarbons, and at least two companies are producing it (along with other chemicals) by this method.

Both methods of synthesis—from carbon monoxide and hydrogen, and by partial oxidation of hydrocarbon gases—appear likely to continue to be used in new plants. Plants built during the war for the synthesis of ammonia are being[13] converted to methanol synthesis, a factor of some economic significance when and if the world-wide shortage of fertilizer is relieved.

According to 1945 Tariff Commission data, synthetic methanol is produced in this country by the American Cyanamid Co.; Carbide and Carbon Chemicals Corp.; Celanese Corp. of America; Cities Service Oil Co.; Commercial Solvents Corp.; and E. I. du Pont de Nemours & Co., Inc. A recent article[13] indicates that the Solvay Process Co., the Spencer Chemical Co., and the McCarthy Chemical Co. will soon be added to this list. Eight other "manufacturers" are listed among methanol sellers in the latest *Chemical Industries* Buyers Guide Section; these are presumably "wood alcohol" producers whose future, incidentally, is far from bright since their costs are considerably higher than for chemical synthesis.

Ethanol

Ethanol, CH_3CH_2OH, may be synthesized in many ways from many materials. Prior to the war, by far the greater portion was produced by fermentation of Cuban, Hawaiian, and domestic blackstrap and invert molasses. However, synthesis from petroleum-derived ethylene was gaining steadily and had depressed prices almost to the point of unprofitability for molasses users.

During the war, demands for alcohol for synthetic rubber synthesis, munitions, etc., made it necessary for whisky producers to convert their plants to alcohol production which they, along with the peacetime molasses-alcohol producers, had to produce from wheat and other high-cost grains, sending alcohol prices skyrocketing even under control. Since the war, the whisky industry has reconverted most of its plants to whisky production, although much of the nonpetroleum ethanol has been produced from grain (mostly corn and potatoes in the fiscal year 1946-47), and the molasses that has been used has been high priced.

Other methods of ethanol synthesis have come into the picture.[3, 10] Waste sulfite liquors from wood pulp production are currently employed in a western plant built for this purpose, while another western plant has been built for production of ethanol

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by the hydrolysis and fermentation of wood wastes. Of great potential significance are the two Synthine synthetic petroleum plants being constructed in Texas and Kansas. A recent estimate points out that ten such plants could produce as a by-product 77% of the nation's high-level 1943-45 consumption of ethanol.

What effect this Synthine by-product ethanol will have on the market—on the processes that will continue to be used for alcohol production—remains to be seen. In the fiscal year 1946-47, 44.6% of the industrial alcohol produced was made from ethylene via the sulfuric acid process (reaction with sulfuric acid, then hydrolysis of the ethyl sulfates), but it has been reported recently that "high-cost ethylene projects are being scrapped in favor of more efficient plants,"[9] some of which, it is reported elsewhere, will produce ethanol by the direct catalytic hydration of ethylene. According to Eugene Ayres,[9] "even the long-term prospects of the lowest cost units are indefinite owing to the possibility of large-scale use of the Fischer-Tropsch (Synthine) process for the synthesis of fuels."

The Tariff Commission's 1945 data shows that American Cyanamid, Carbide and Carbon, du Pont, and the Standard Oil Co. of New Jersey (Louisiana Division) were producers of synthetic ethanol in that year, and Shell is reported to be building an 18,000,000 gal./year plant in Texas. Commercial Solvents, Monsanto, Publicker, U. S. Industrial Chemicals, and Dill-Hough are listed by *Chemical Industries* as ethanol "manufacturers," presumably by fermentation, and others are in this field, for example the producer of alcohol from waste sulfite liquors.

Whatever the future, petroleum and natural gas will continue to be the most important raw materials, at least for some time.

Isopropanol

Isopropanol, $CH_3CH_2OHCH_3$, was the first alcohol to be produced commercially from petroleum, in this case from propylene. It continues to be so produced, by reaction with sulfuric acid followed by hydration of the sulfates formed.

Isopropanol is produced by Carbide and Carbon, Shell, and the Standard Oil Co. of New Jersey (Stanco and Louisiana Divisions—presumably marketed through Enjay Co., Inc.). Two other "manufacturers" are listed by *Chemical Industries.*

Ethylene Glycol

Ethylene glycol, $CH_2OH \cdot CH_2OH$, is produced from ethylene by two different processes: (1) reaction with hypochlorous acid and alkali hydrolysis of the resulting chlorohydrin, and (2) catalytic partial oxidation to ethylene oxide, followed by hydrolysis of the latter. The first process was that initially developed by the Carbide and Carbon Chemicals Corp., first commercial producers of this substance; the second process was also patented by Carbide and Carbon, but it is reported that the basic patents were invalidated on a legal technicality. In any event, both processes continue in use by several producers, others having entered the market since Carbide's chlorohydrin-method patents expired early in this decade.

At least one potential producer will manufacture mixtures of ethylene and propylene glycol by charging mixtures of ethylene and propylene to the chlorohydrin process, thus avoiding costly ethylene purification. The mixed glycols will presumably be marketed as such, probably for antifreeze use.

Ethylene glycol is currently produced chiefly by Carbide and Carbon, the Dow Chemical Co., and du Pont. The Wyandotte Chemical Corp. and the Jefferson Chemical Co. are among those completing new plants. The Tariff Commission's reports do not show the U. S. Industrial Chemicals Co. as a producer since the 1941-43 period, although their plant precipitated the litigation on the patent on the ethylene oxide method of synthesis. Eimer & Amend is listed as a "manufacturer" by *Chemical Industries.*

Glycerine

Glycerine, $CH_2OH \cdot CHOH \cdot CH_2OH$, has long been produced chiefly as a by-product from soap manufacture. Recently, however, a subsidiary of the Shell Oil Co. has completed a plant to produce it from propylene by a several-step, chlorination-hydrolysis process.

The war has left behind it many problems, chief of which at present is the demand for many substances whose production is limited by the capacities of prewar plants and the few built during the war. This situation is as true for the antifreeze materials as it is for the automobiles that use them.

For this reason, recent statistics shown in Figs. 2, 3, and 4 must be carefully analyzed for their true meaning. From Fig. 2 and Table 4, for example, it would seem that ethanol has been given a real rebirth as an antifreeze material and that synthetic methanol and ethylene glycol, after showing glowing prewar promise, are of uncertain future, especially the latter.

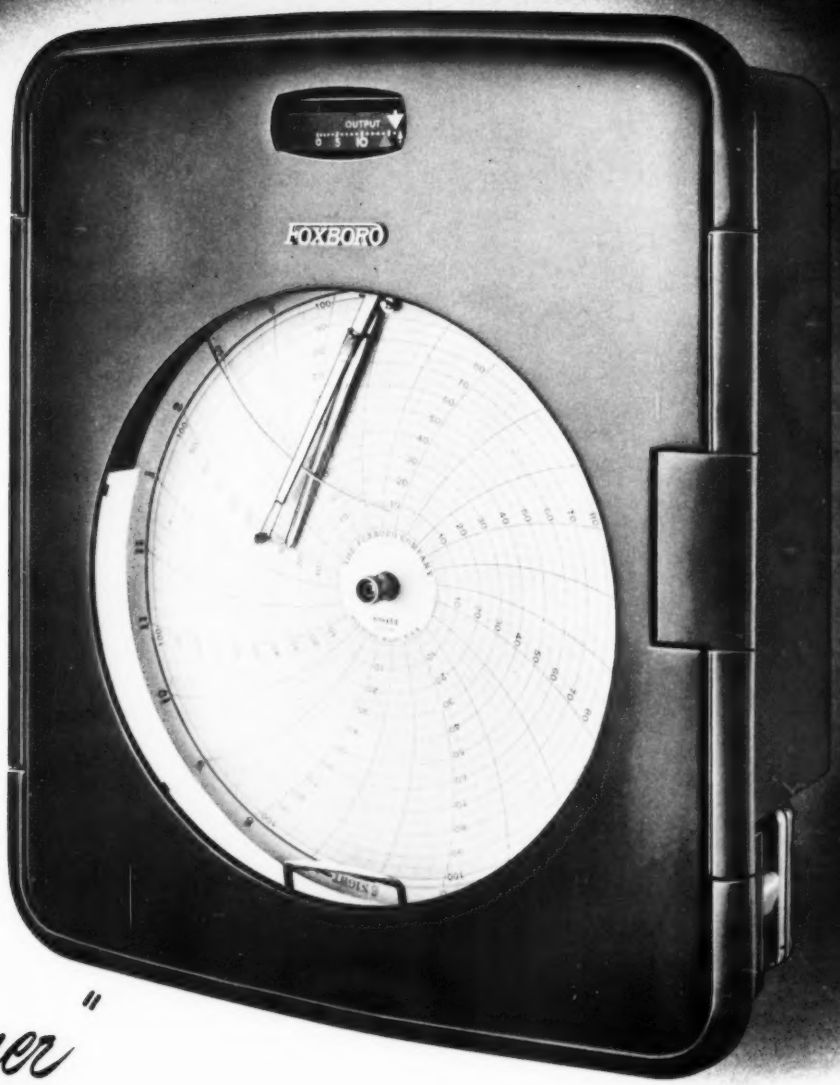
Nothing could be farther from expectations. The truth is that synthetic methanol is in great demand for its other uses (formaldehyde and other chemical synthesis, etc.), as is also ethylene glycol (for explosives, cellophane, coolants, chemicals, resins, hydraulic fluids, textiles, etc.). Consumer preference gives every indication that more and more methanol and glycol antifreezes will be used, when and as they become available, and that ethanol may even fade from the picture as did glycerine in 1936. Even for the current 1948-49 winter season, "glycol will probably go up and methanol certainly will, at the expense of ethanol."[7]

Fig. 4 serves to give an inkling of the spread between the cost of the antifreeze materials and the retail prices of the packaged, inhibited antifreezes. Open-market ethylene glycol prices have fallen considerably in recent years, yet the permanent-type antifreezes continue to sell for $2.65

TABLE 4—United States Consumption of Antifreezes*
(100,000 U. S. Gallons)

Year	Total	Glycol	Ethanol	Isopropanol	Glycerine	Synthetic Methanol	Misc. & Natural Methanol
1931-32	50,100	600	46,000		1,000	2,000	500
1934-35	46,600	4,000	36,000	800	800	5,000	
1935-36	44,800	8,200	27,900	1,500	200	7,000	
1936-37	50,500	9,000	32,400			9,100	
1937-38	44,800	9,000	23,300	2,000		9,500	1,000
1938-39	41,500	9,000	20,000	2,000		9,500	1,000
1939-40	42,000	9,000	20,000			13,000	
1940-41	48,000	11,000	21,000			14,000	2,000
1941-42	55,320	15,750	19,250	1,920		18,400	
1945-46	58,000	13,000	45,000				
1946-47**	70,000	13,500*	36,500			20,000	
1947-48***	70,000	12,000	42,000	***		25,000***	

* Data for 1931-32 through 1945-46 from Zink, D. G., *Diesel Power* 25, No. 11, 14 (1947).
** Data from Stenerson, H., *Chemical Engineering* 25, No. 38, 2782 (1947). Glycol consumption may have been as high as 15,000,000 gallons.
*** Estimates in a private communication from James G. Park, Enjay Co., Inc., Jan. 19, 1948. The figure for synthetic methanol includes methanol-isopropanol mixtures.



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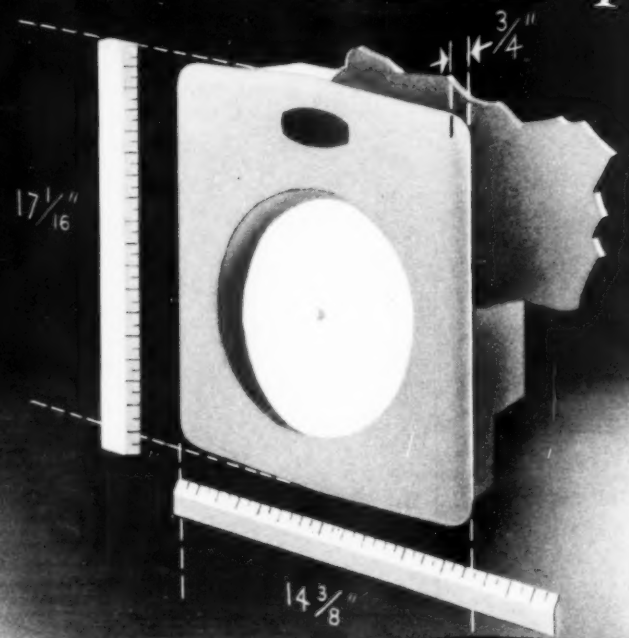

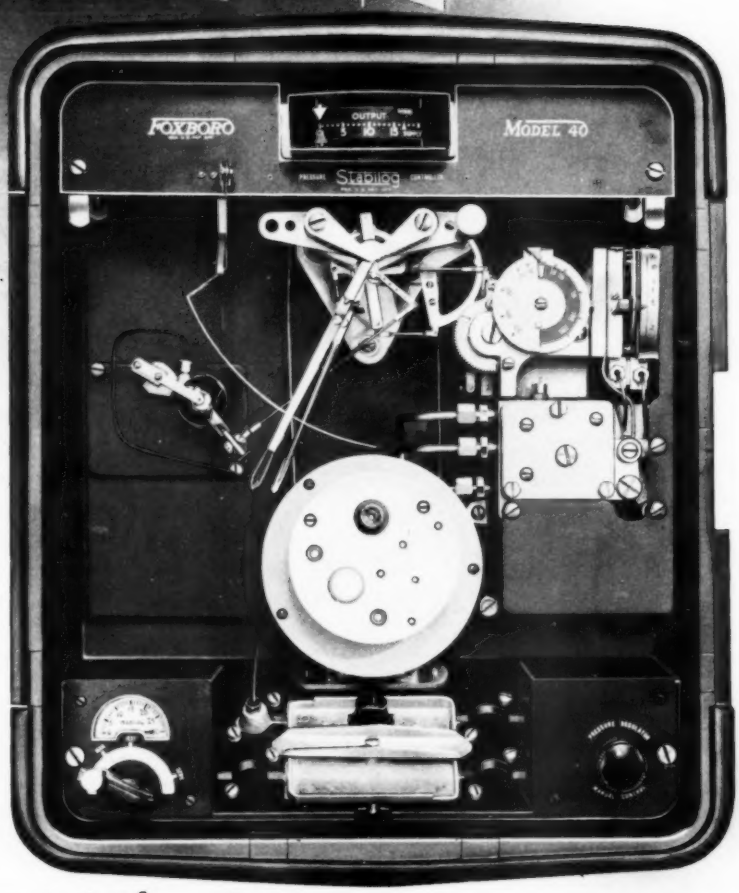

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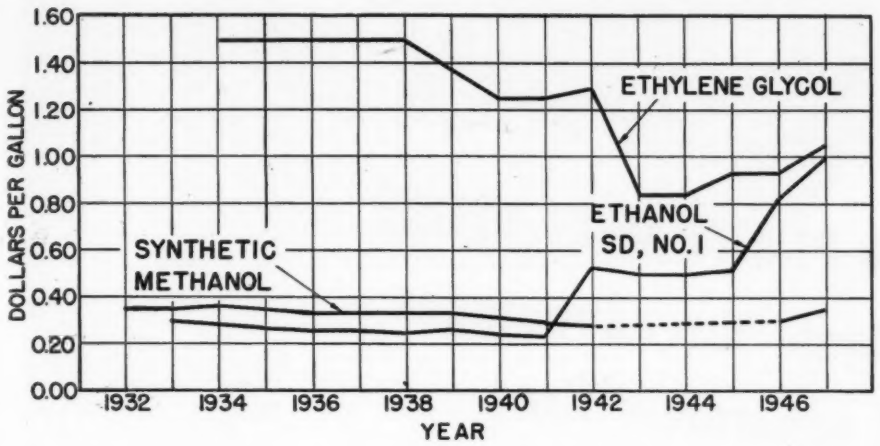

Fig. 4—Average prices of antifreeze materials in New York open market

per gal. Prior to the war, only one manufacturer produced ethylene glycol; now, it is made by several, and competition may be keen if and when total production exceeds demands. As regards synthetic methanol and ethanol (SD, No. 1), recent price trends are explained by the figures shown in Fig. 4. It should be noted, incidentally, that the denatured ethanols actually used in antifreezes are usually of the completely denatured (CD) varieties which sell for 2-4c gal. more than the specially denatured (SD) ethanols.

In further regard to the prices of antifreeze materials, it should be remembered that the bulk of these substances are used by their producers or are sold under contract at stable prices, often well below open-market levels. Thus, the U. S. Tariff Commission figures for 1945 show "unit sales values" of 3c lb. for synthetic methanol and 10c lb. for ethylene glycol (roughly 20c and 93c per gal. respectively), indicating that methanol, at least, was selling on contract for less than open-market levels. Synthetic ethanol is known to have been selling for years at prices in the 20-30c per gal. range.

Incidentally, "as far as manufacturers are concerned, the antifreeze season gets under way in April and ends with August. Shipments to retail outlets above the Mason Dixon line usually are completed before March. Below that imaginary divide the movement is over as early as December."(8)

Production figures shown in Fig. 3 are interesting but not indicative, in view of the total market for the alcohols. Methanol production is expected to approximate 110,000,000 gals. this year, and methanol production capacity in 1949 may reach 150,000,000 gals, about double the 1947 output.(13) New producers will also add materially to the output of ethylene glycol within the current year. Synthetic ethanol production will presumably continue to increase, possibly at prices which will keep ethanol antifreezes in the picture. Trade names may have this same effect if prices are competitive with methanol antifreezes.

It should be noted (Fig. 2) that the total market for antifreezes has not increased tremendously with the years and that, even with unlimited automobile production, it will probably not exceed 100,000,000 gals. for at least several years—perhaps never if sealed cooling systems come into use. One authority states that, since "the average consumption of antifreeze per car is approximately two gallons per car per season . . . there are approximately 70,000,000 gals. of antifreeze consumed annually in this country."(7)

For the recent winter season, Eugene Ayers pointed out that the petroleum industry was believed to be distributing 7,000,000 gals. of glycol, 18,000,000 gals. of ethanol, and 9,000,000 gals. of methanol. It may readily be seen, then, that the industry has a very real interest in the future production and sales of antifreezes, especially since it has been intimated that automotive jobbers are being given the distribution of the lion's share of at least the permanent-type antifreezes, also that oil jobbers are not being allowed normal margins of profit.(6) At least two major oil companies are marketing their own brands of permanent-type antifreeze this winter—one through actual manufacture and the other by contract with another manufacturer.

It has been pointed out (9, 10) that the would-be manufacturer of antifreezes as well as of other chemicals from petroleum must consider many economic factors before entering the field—patent rights, raw material supplies, costs, competing products, etc. Moreover, he must consider all the possible uses for his products and the by-products inevitably involved, and must also consider the economics of manufacturing other chemicals from the same raw materials. The availability of ethylene, for example, does not mean that ethylene glycol will necessarily be the most profitable derivative; even the manufacturer of ethylene oxide may find it more lucrative to produce glycol ethers and esters instead of ethylene glycol.

Obviously, the previously-mentioned market of 70,000,000-100,000,000 gals. of antifreeze per year would not require many chemical plants to produce the materials required; Eugene Ayres points out, for example, that "the present production of synthetic methanol in the U. S. is only 40% of the methanol which could be manufactured from the natural gas that is burned in the Greater Pittsburgh area alone."(9)

For this reason, few petroleum companies will be able to consider the production of antifreezes as an operation distinct from the manufacture of other substances or the production of these same chemicals for other uses. Nevertheless, it seems certain that the chemical industry will receive increasing competition in this field, in which the spread between raw material costs and those of the retail products is unusually lucrative, especially for the integrated company.

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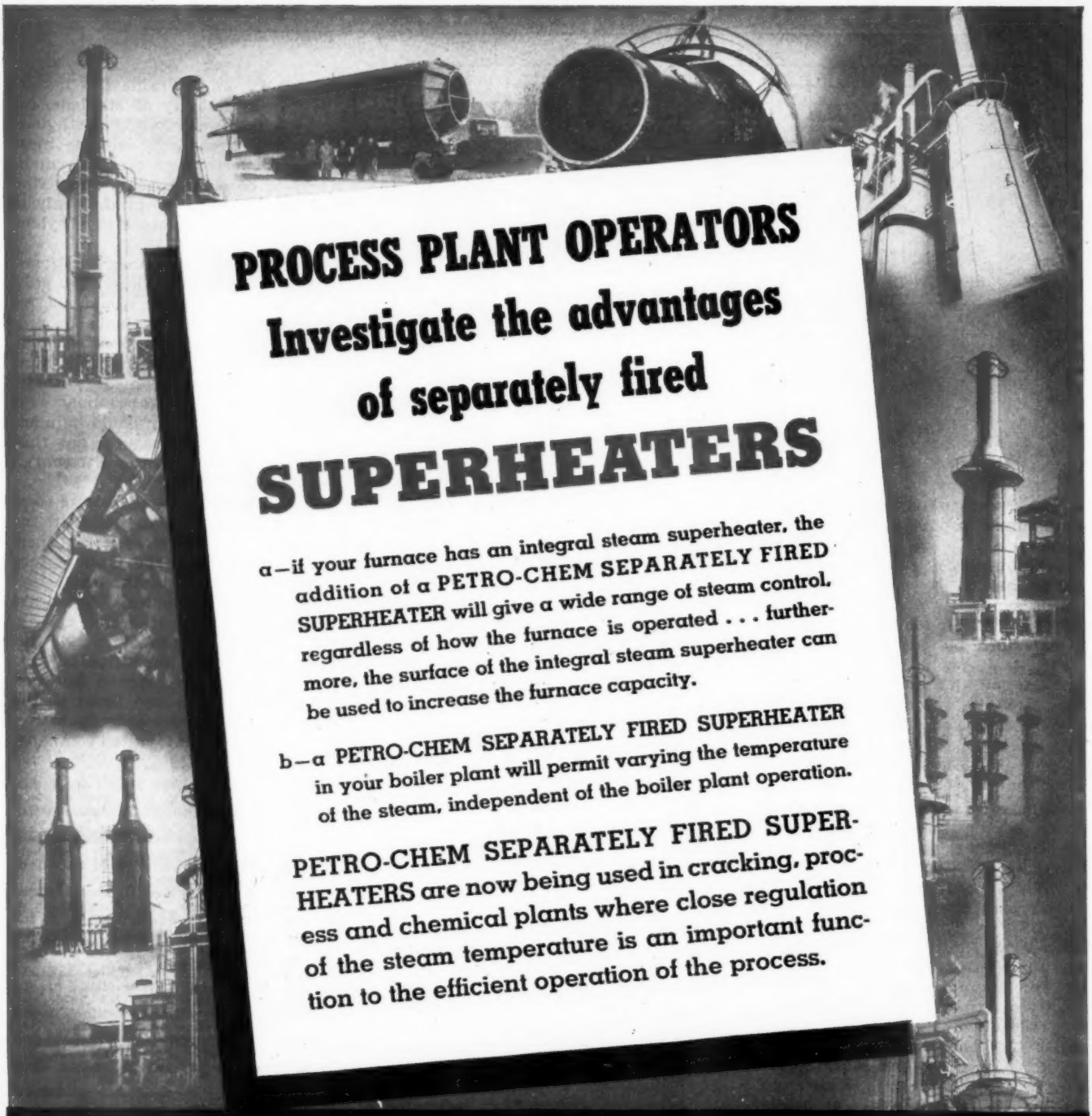

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Plant Practices

Refinery Pipe Fabrication Time Reduced With Marking Jig for Cutting Weld Ells

THE JOB OF LAYING OUT and marking welding ells for accurate cutting of angular turns in the past has required considerable time and trouble in the maintenance shops at Sinclair Refining Co.'s Marcus Hook refinery. Recently, a large construction program presented a great increase in pipe fabrication jobs with many such angular cuts to be made.

In order to handle the increased load on shop facilities, a layout jig was designed and built. It is illustrated in the photograph and in the sketch in Fig. 1. The jig is fabricated from two pieces of scrap 18-in. "I" beams 30 in. long. The top flange on each beam is burned off just back of the flange. The bottom flanges are used as a base, with one end mitered to form a 90° angle when the ends are fitted together.

Legs are made from pipe as shown, and are fitted with casters for easy mobility. Across the front—from the outer end of each "I" beam—a piece of flat bar is marked off in degrees from 0 to 90. The horizontal bars which contact tangentially the welding ell are adjustable for various diameters up to 24 in. When an ell is placed in the jig a chain is run through it and pulled up with a screw from an old pipe vise until the ends of the ell fit snugly against the "I" beams. It is then only necessary to move the marking bar to the desired degree and mark the ell accordingly, using a template, if desired.

No definite cost for the jig has been established. Scrap material was used throughout, and welders required only a few hours to make the assembly. Whenever jobs call for a great deal of welding ell cutting, time saved over the old methods of laying out each turn by hand can pay almost immediately for the jig. pay almost immediately for this easily-built layout jig.

Right: layout jig with a welding ell in position ready for marking off the desired angular cut

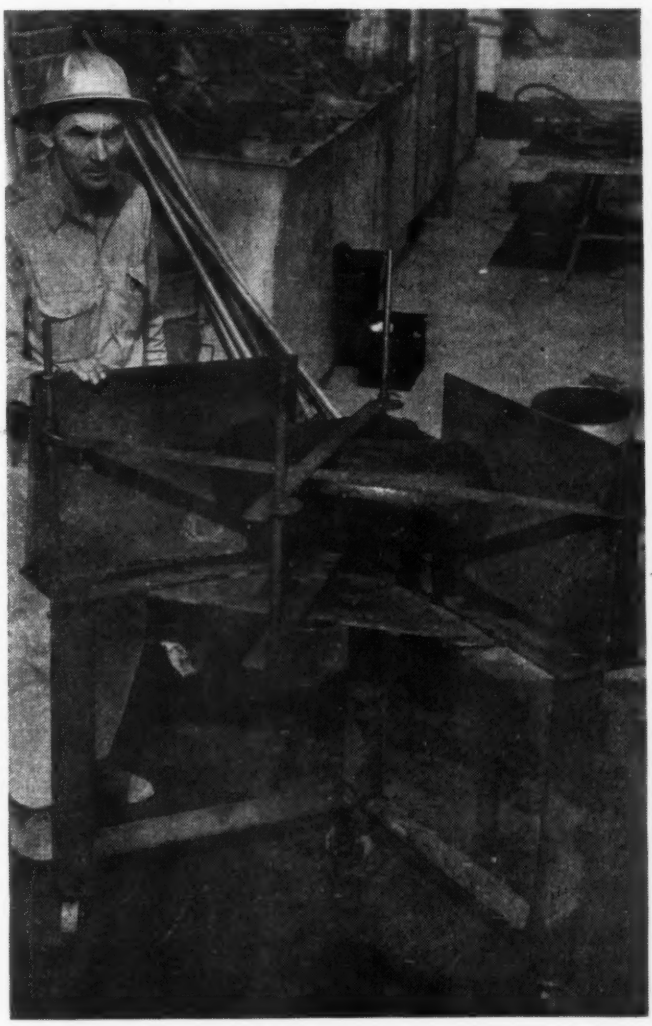
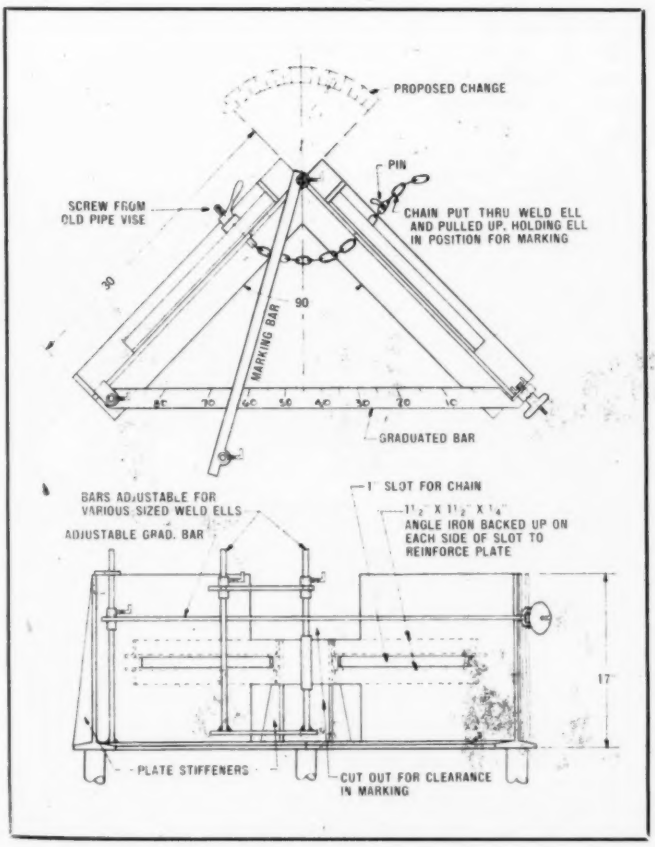


Fig. 1—Below: plan and elevation views of layout jig for cutting welding ells


PROPOSED CHANGE
PIN
SCREW FROM OLD PIPE VISE
CHAIN PUT THRU WELD ELL AND PULLED UP, HOLDING ELL IN POSITION FOR MARKING
30
90
MARKING BAR
GRADUATED BAR
BARS ADJUSTABLE FOR VARIOUS SIZED WELD ELLS
ADJUSTABLE GRAD. BAR
I SLOT FOR CHAIN
ANGLE IRON BACKED UP ON EACH SIDE OF SLOT TO REINFORCE PLATE
17
PLATE STIFFENERS
CUT OUT FOR CLEARANCE IN MARKING

Temperature Indicator Eliminates Need For Pig in 12-mile LPG Products Pipeline

By GEORGE D. RHOADS, Ass't. Superintendent
Trinity Gas Corp., Hebbronville, Texas

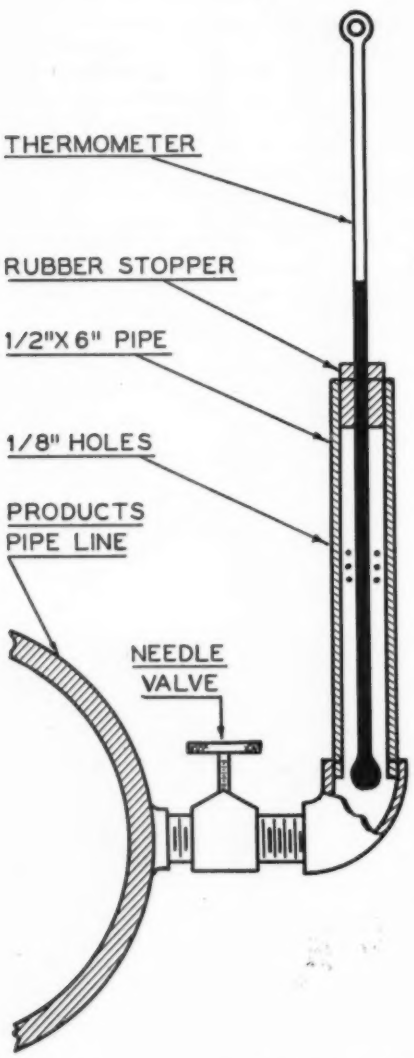


Fig. 2—Fitting attached to end of LPG products line gives quick check on various products passing through line

THE liquefied petroleum gas products pipe line between Trinity Gas Corp.'s plant and the loading rack is approximately 12 miles in length. It is used to handle both commercial propane and butane, and the use of a pig to separate these products in the past has been troublesome and expensive.

As a means of obtaining a quick separation without the use of a pig, the simple device shown in Fig. 2 was designed and adopted. It is a fitting attached to the receiving end of the pipe line, and comprises a short ¼-in. nipple, a ¼-in. needle valve, another short ¼-in. nipple, a ½ to ¼-in. reducing ell, and a 6-in. length of ½-in. pipe.

A thermometer of the appropriate range inserted in the ½-in. pipe through a rubber stopper provides a rapid check on initial boiling point differences as produced by the fluid passing through the line. A few ⅛-in. holes drilled through the ½-in. pipe about 3 in. above the ell serve to release any vapors that accumulate. In use, the needle valve is cracked at intervals to check the IBP when a change of products is expected.

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Plant Practices Editor
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Lathe Dog Stops Damaged Shaft Threads During Cleaning or Scarifying Operation

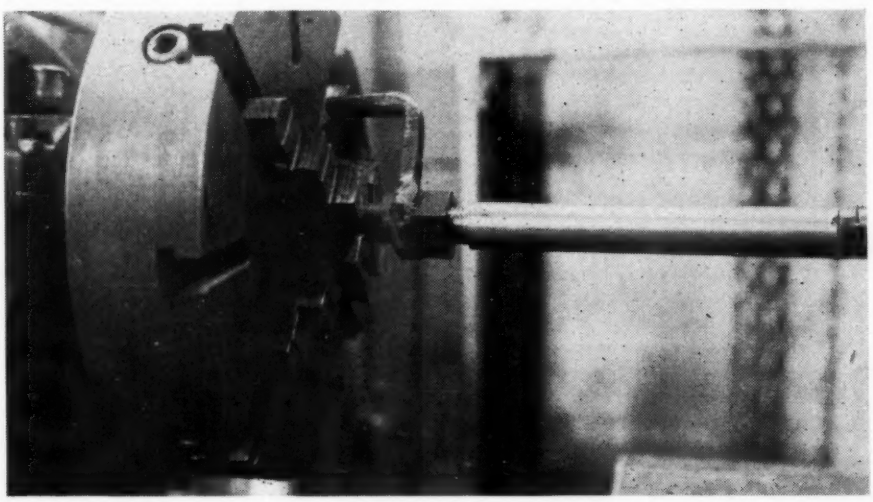
By JOHN C. ALBRIGHT

WHEN A SHAFT with threads on both ends is to be turned down, a handy little lathe dog can be made that will preserve the original condition and pitch so the threads will not have to be re-cut with a chaser die.

Two approaches can be used toward making a tool of this kind. The simplest method is to obtain two hexagonal nuts, one to fit the threaded end of the shaft and the other having the same outside diameter but smaller inside. These nuts are matched face to face and welded so the shaft will screw into the larger nut and shoulder against the face of the smaller one.

The other method is to drill and tap one end of a short piece of hexagonal bar stock with threads to match the end of the shaft, tapping just deep enough to hide all but one thread on the shaft. A smaller, concentric hole is then drilled through to the opposite end of the hexagonal piece. Again, a smooth, square shoulder at the inner end of the larger hole provides a top for the flat end of the shaft.

A length of bar stock is then welded to the resultant piece from either method, and is shaped in the form of a conventional lathe dog. The shaft is chucked in the head stock with a head stock center bar long enough that the dog and shaft will clear the jaws of the lathe.



Lathe dog prevents damage to threaded end of shaft being turned down, cleaned, or scarified before metallizing

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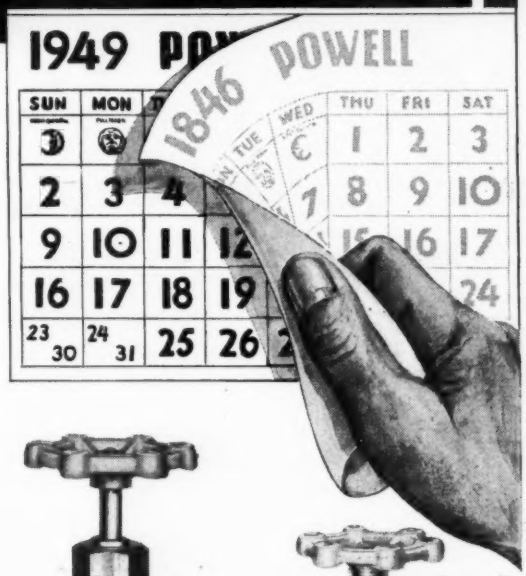

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Fig. 1793—Large 125-pound Iron Body Bronze Mounted Gate Valve. Made in sizes 2" to 30", inclusive. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge. Also available in All Iron for process lines.

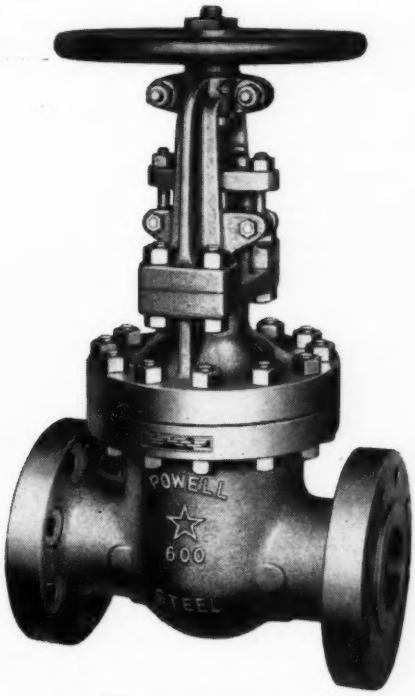

Fig. 6003—Class 600-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 375 — 200-pound Bronze Gate Valve. Screwed ends, union bonnet, inside screw rising stem and renewable "Powellium" wear-resisting nickel-bronze disc.

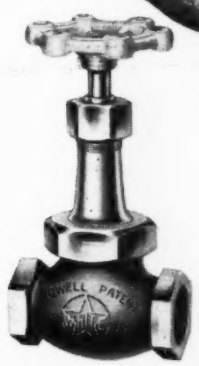

Fig. 1708 — 200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable wear-resisting "Powellium" nickel-bronze disc.

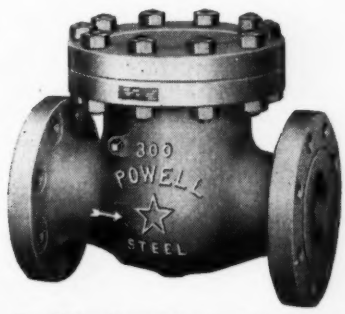

Fig. 3061—Class 300-pound Cast Steel Swing Check Valve with flanged ends and bolted flanged cap.

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POWELL VALVES

Laboratory Practices

Find Specific Gravity of Gases Rapidly With Improved Design in Gravitometers

By O. H. DAWSON and J. A. SNYDER
Humble Oil & Refining Co., Baytown, Texas

RAPID AND PRECISE determinations of the specific gravities of gases can be accomplished readily in equipment based on the principle of measuring, on an inclined tube water manometer, the difference in static heads at the bottom of two tubes, approximately 35 ft. high, one containing the gas sample, and the other containing air. Both gases are under the same conditions of temperature and humidity.

The apparatus is simple, easily constructed, and inexpensive. It is particularly suitable for determining the specific gravity of a large number of gas samples in control testing. The deviation of values from those given in the literature is less than 1.0%. Where individual vertical tubes are provided for each gas to be tested, gravities may be obtained at the rate of one per minute, and any one sample may be evaluated successfully at three minute intervals. The values obtained are comparable in accuracy to those obtained by other well known instruments, such as the Anubis gravitometer.

The principle of balancing equal heights of gas against each other is old. An earlier development in a specific gravity meter employed a system for balancing columns of gas against each other with the weights of the different gases being indicated on a balance. Reports indicate that the device is quite complicated.

The present apparatus is illustrated in Fig. 1 and comprises the following pieces:

1. A 6-mm. inside diameter inclined tube water manometer (slope, 25 horizontal to 1 vertical), 24 in. long, with the low end connected to a 500 cc. reservoir, and equipped with a movable scale. The scale is calibrated to indicate directly the gravity of the gas sample relative to air, or in any other units desired.

2. A manifold assembly of 4-mm., 3-way stopcocks (one for air and one for each gas to be tested), and two 4-mm., 2-way stopcocks for establishing atmospheric pressure on each end of the manometer.

3. Required number of ¼-in. diameter tubes (one for air and one for each gas to be tested), extending upward to height of about 35 ft.

4. An air saturator. (A gas saturator also is required if gas has not already come into contact with water in a gas meter.)

5. A water seal, 2 in. deep, into which the by-pass lines from the air and gas lines are submerged.

The operation of the device can best be described by referring to Fig. 1. Between readings, the water-saturated air and the water-saturated gas pass to the 3-way cocks, B, C, and D, and through the ¼-in. tubes 35 ft. high. The diameter of the tubes may be greater than ¼ in., but such that it may be displaced with the gas being tested in three minutes or less. The 2-way cocks, A and E, are open during this period to "zero" the scale on the manometer at 1.0.

When a gravity determination is to be made, cocks A and E are first closed. Cocks B and C are turned 90° counterclockwise, thereby stopping the flow of air and of Gas No. 1, and at the same time imposing static heads on opposite ends of the manometer. During this period the flow of air and of Gas No. 1 is directed through the water seals.

After the gravity of Gas No. 1 has been read on the scale, cock C is turned to its original, or "feeding", position and cock D is turned 90° to the left, and the gravity of Gas No. 2 is determined. After all gas

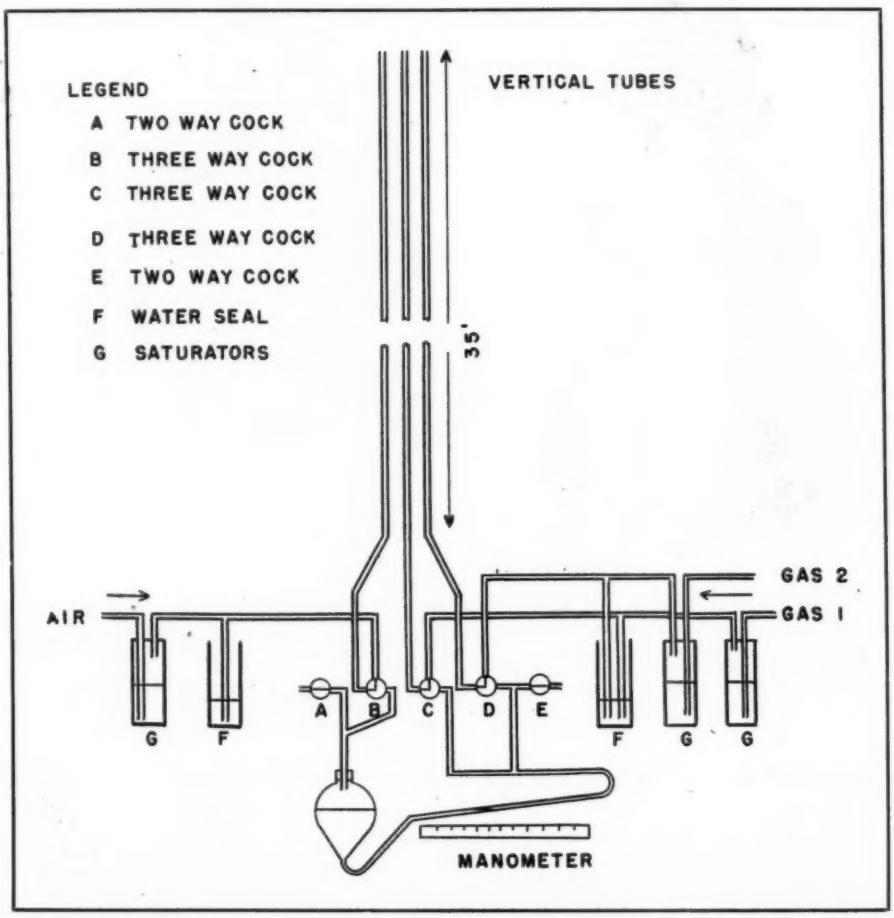
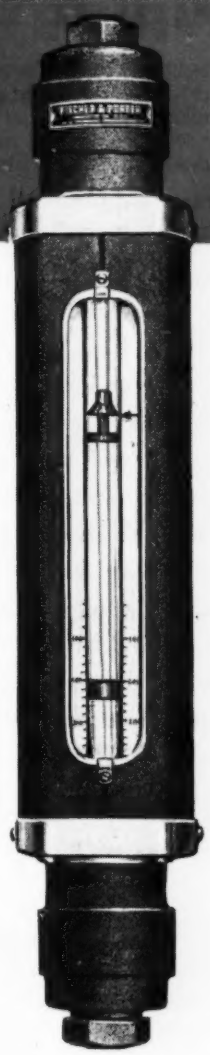


Fig. 1—Schematic layout of rapid gas gravitometer utilizing an inclined tube water manometer

VISCOSITY MEASUREMENT



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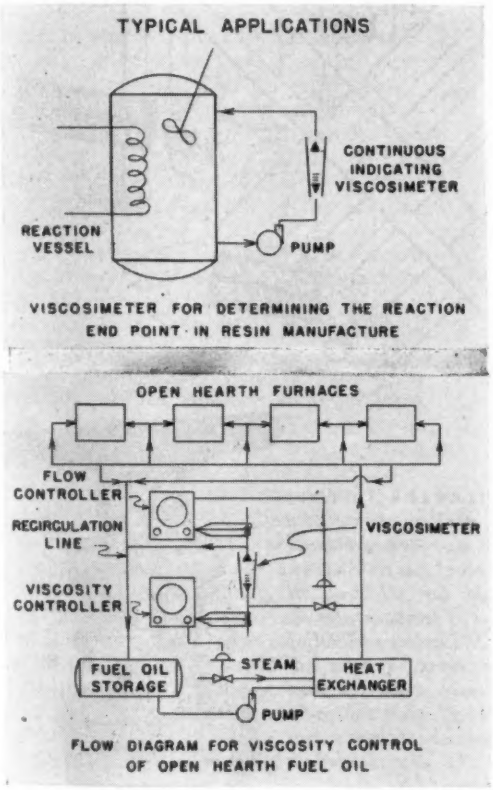

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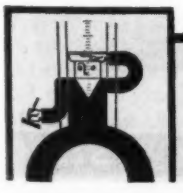

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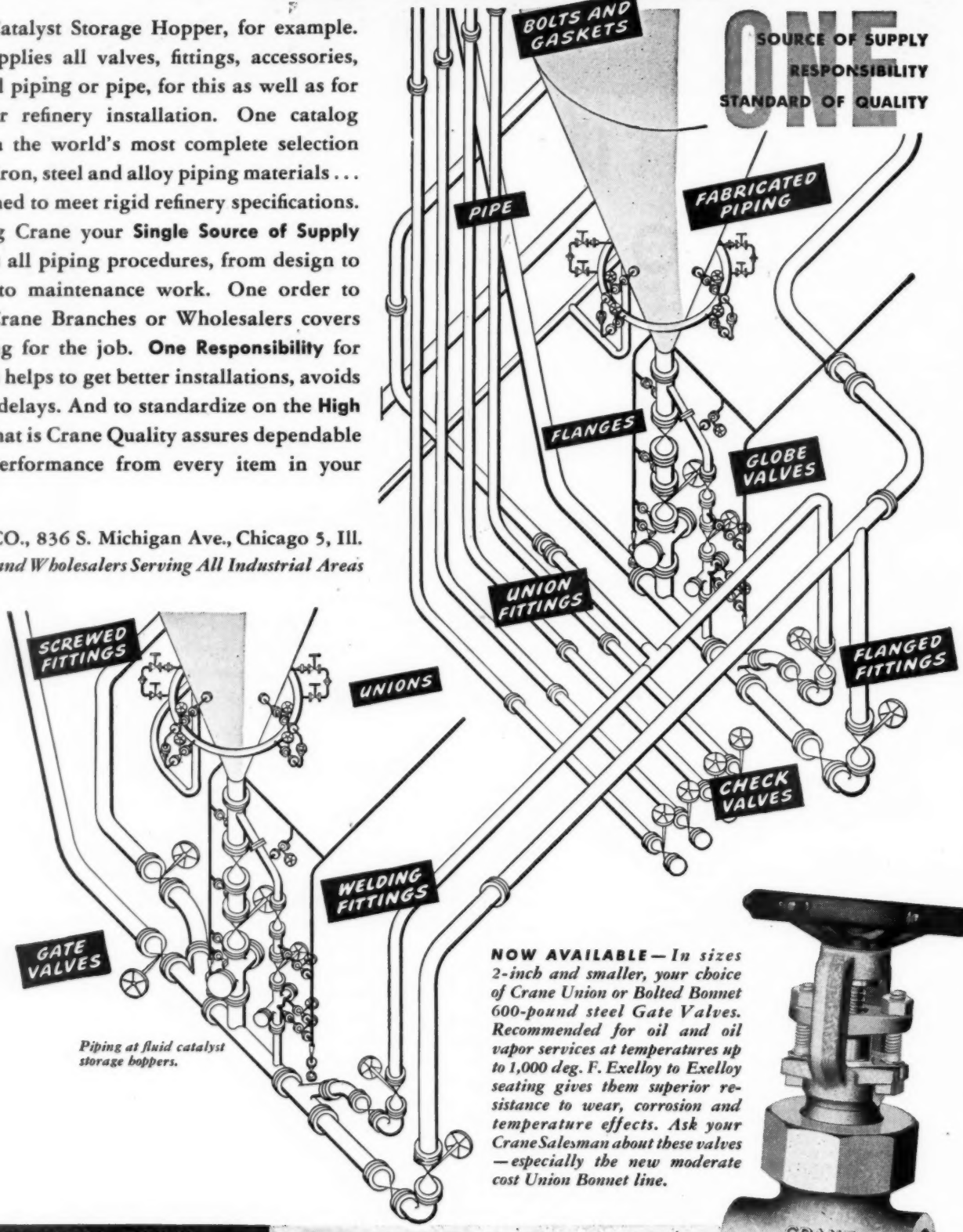

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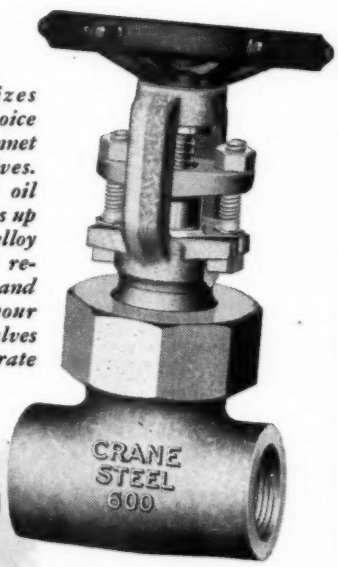

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TABLE 1—Comparison of Gas Gravities from Various Sources

Gas Tested	Hydrogen	Ethane	CO_2	Cracked Gas	Cracked Gas
Specific Gravity:					
Handbook Value	0.0695	1.049	1.53	....	....
Anubis Gravitometer	.....	....	...	0.985	1.065
Manometer Apparatus	0.0700	1.040	1.53	0.992	1.065
Deviation	+0.0005	—0.009	0.0	+0.007	0.0

gravities have been determined, all the cocks are turned to the original position and left until another determination is to be made.

Calibration of the apparatus is accomplished as follows. The manometer scale reading is a function of the height of the vertical tubes and the slope of the manometer tube as well as the density and water content of the gases. The manometer, clamped in a rigid position, is calibrated with air and known gases that are saturated with water, such as carbon dioxide, hydrogen, and nitrogen. It has been found convenient to plot first the known specific gravities of each gas against the corresponding reading in millimeters on the manometer. From this plot a scale reading directly in gas gravity can be prepared for insertion on the manometer. If dry gases are to be balanced against dry air, a separate calibration is required.

It is convenient, although not necessary, that a vertical tube be provided for each gas. Several gases, however, may be passed up the same tube successively. With each gas passing up its individual tube, all of the gravities may be taken rapidly by alternate operation of the several 3-way stopcocks.

Care should be taken to saturate (or dry) both air and gas passing up the vertical tubes so that no correction need be applied for moisture content.

All connections leading from the vertical tubes should slope toward the stopcock assembly to prevent moisture or condensate from sealing the tubes or lines. It is good practice to blow the tubes downward once each week with air, using care not to blow water out of the manometer. Sluggish movement of the water in the manometer usually will indicate an obstruction in one of the tubes or lines. A few drops of a detergent such as Aerosol should be added to the manometer water to reduce surface tension and increase the accuracy of the readings.

The top of the vertical tubes should be shielded against air currents. These deflect the manometer and cause error in gravity evaluations. All the vertical tubes should be placed adjacent to each other to permit equivalent temperature changes on all tubes. If calibrated with water-saturated gases and air, care should be taken to saturate the gases and air at about the same temperature at which the gases and air are saturated during routine use so that the water content is the same at all times. The inlet temperatures of the air and gases flowing into the apparatus should be essentially the same.

The vertical tubes may be any length greater than about 10 ft. The optimum length will depend upon the manometer slope as well as the desired maximum variation in the magnitude of the observed gas gravities.

In Table 1, readings taken of the specific gravities of several gases are compared with similar readings taken on an Anubis gravitometer or with known values taken from a handbook. In every case the deviation of the rapid manometer readings is less than 1.0%.

There is a day-to-day error, resulting from changes in atmospheric temperature (temperature in the vertical tubes) and barometric pressure. Compensation can be made for these errors by means of the following equation:

$$(p\text{-}1) = (Pc/Po)\ (To/Tc)\ (p'\text{-}1)$$

where:

- p = corrected specific gravity relative to air.
- p′ = observed specific gravity relative to air.
- Pc = barometric pressure at time of calibration, mm. Hg.
- Po = observed barometric pressure, mm. Hg.
- Tc = atmospheric temperature at time of calibration, °R.
- To = observed atmospheric temperature, °R.

For a gas of 0.7 gravity, the error in gravity reading corresponding to normal changes in the temperature and barometric pressure variables will be no more than 0.01, which is about the same as the limits of accuracy of the apparatus.

Ten Fragile Glass Agitators Replaced By Single 16-gallon Shop-built Mixer

By BLAINE F. NEWMAN, Chemical Engineer
The Texas Co., Lockport, Ill.

A MIXING TANK made from an old 100-lb. grease drum fills a gap in desired capacity between the largest glass agitators—about 2½ gals.—and the smallest, commercial, metal tank agitators—100 gals. One such blender, with a capacity of about 16 gals., supplants 7 to 10

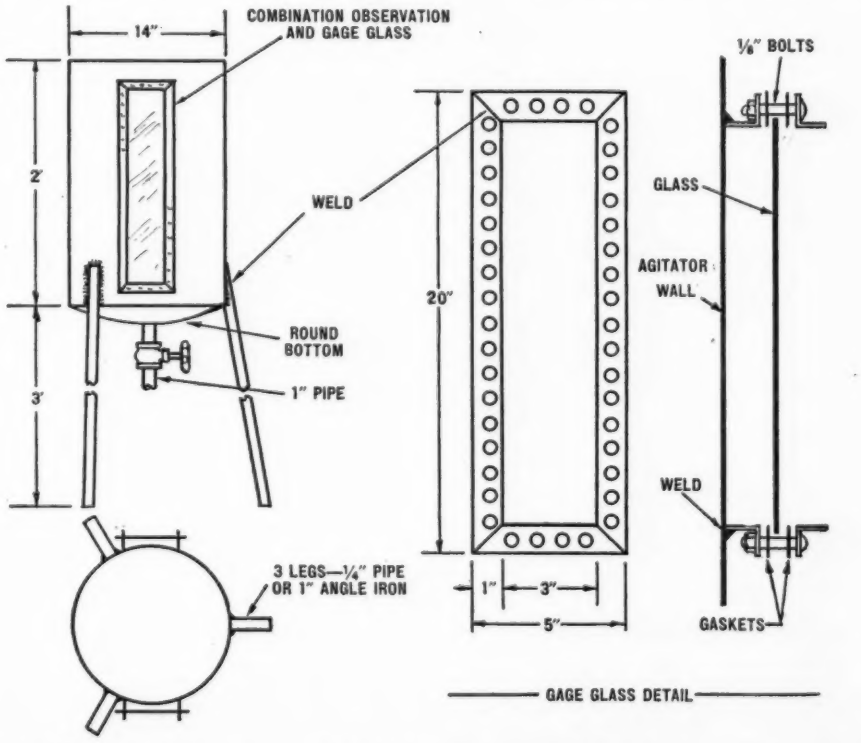

Fig. 2—Side and top views of 16-gal. agitator, and detail of construction of glass observation windows

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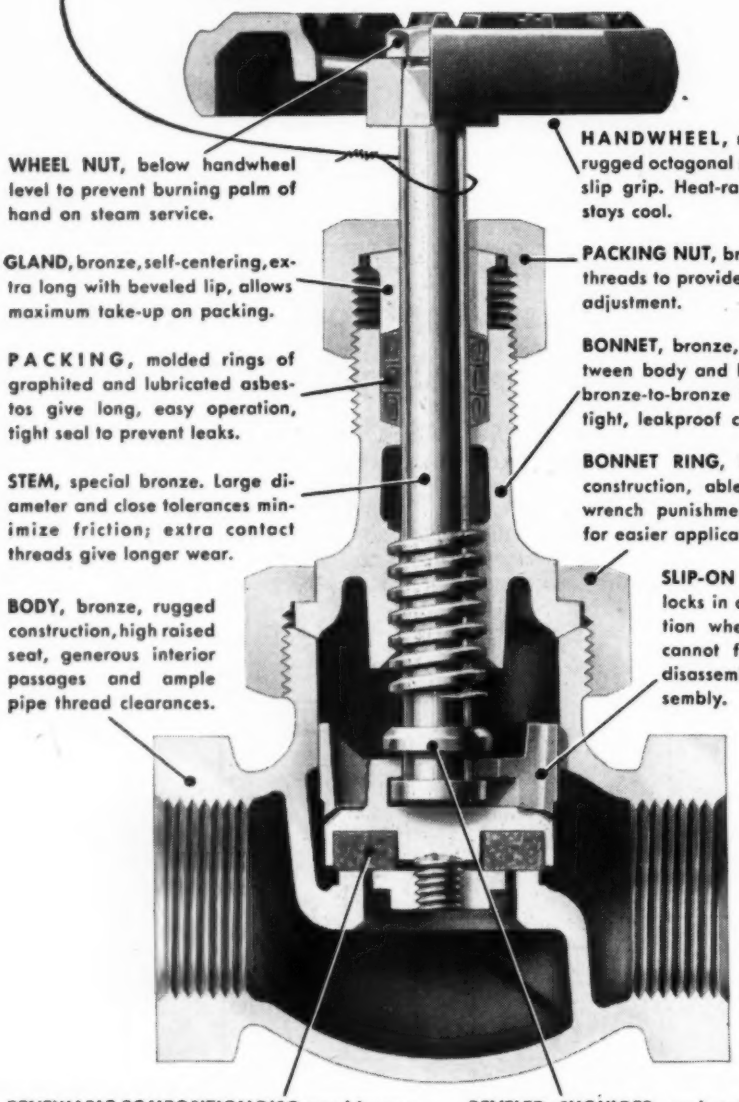

WHEEL NUT, below handwheel level to prevent burning palm of hand on steam service.

HANDWHEEL, malleable iron, rugged octagonal shape, for non-slip grip. Heat-radiating design stays cool.

GLAND, bronze, self-centering, extra long with beveled lip, allows maximum take-up on packing.

PACKING NUT, bronze with long threads to provide extra packing adjustment.

PACKING, molded rings of graphited and lubricated asbestos give long, easy operation, tight seal to prevent leaks.

BONNET, bronze, with joint between body and bonnet making bronze-to-bronze true union for tight, leakproof construction.

STEM, special bronze. Large diameter and close tolerances minimize friction; extra contact threads give longer wear.

BONNET RING, bronze, heavy construction, able to withstand wrench punishment. Large flats for easier application of wrench.

SLIP-ON DISC HOLDER, locks in a definite position when wide open, cannot fall off during disassembly and reassembly.

BODY, bronze, rugged construction, high raised seat, generous interior passages and ample pipe thread clearances.

RENEWABLE COMPOSITION DISC, provides perfect seating; asbestos for steam service and special types for various services and temperatures.

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glass agitators formerly used in The Texas Co., Lockport refinery laboratory, for treating and blending lube oils. Its strength gives it an additional advantage over the comparatively fragile glass mixers.

The unit is shown in the dimensioned drawing in Fig. 2. The grease drum, or a small oil drum, is mounted as indicated on three legs, which may be either angle iron or small diameter pipe. Two windows are used, serving both for observing the action and as gage glasses.

A pressure top can be designed for operating the agitator under slight pressure or with an inert gas if desired. The bottom has been pounded down to form a rounded shape for completely emptying the contents through a one-in. valve and pipe drain assembly.

Run Pour Tests at −90 F. In Dry Ice Lab Freezer

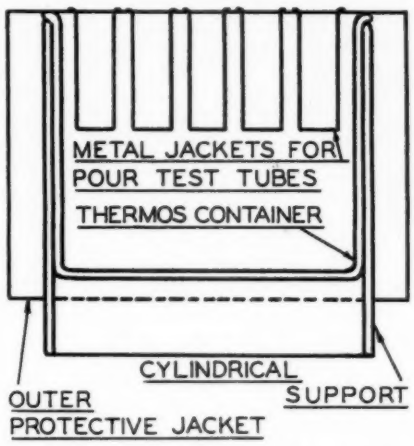
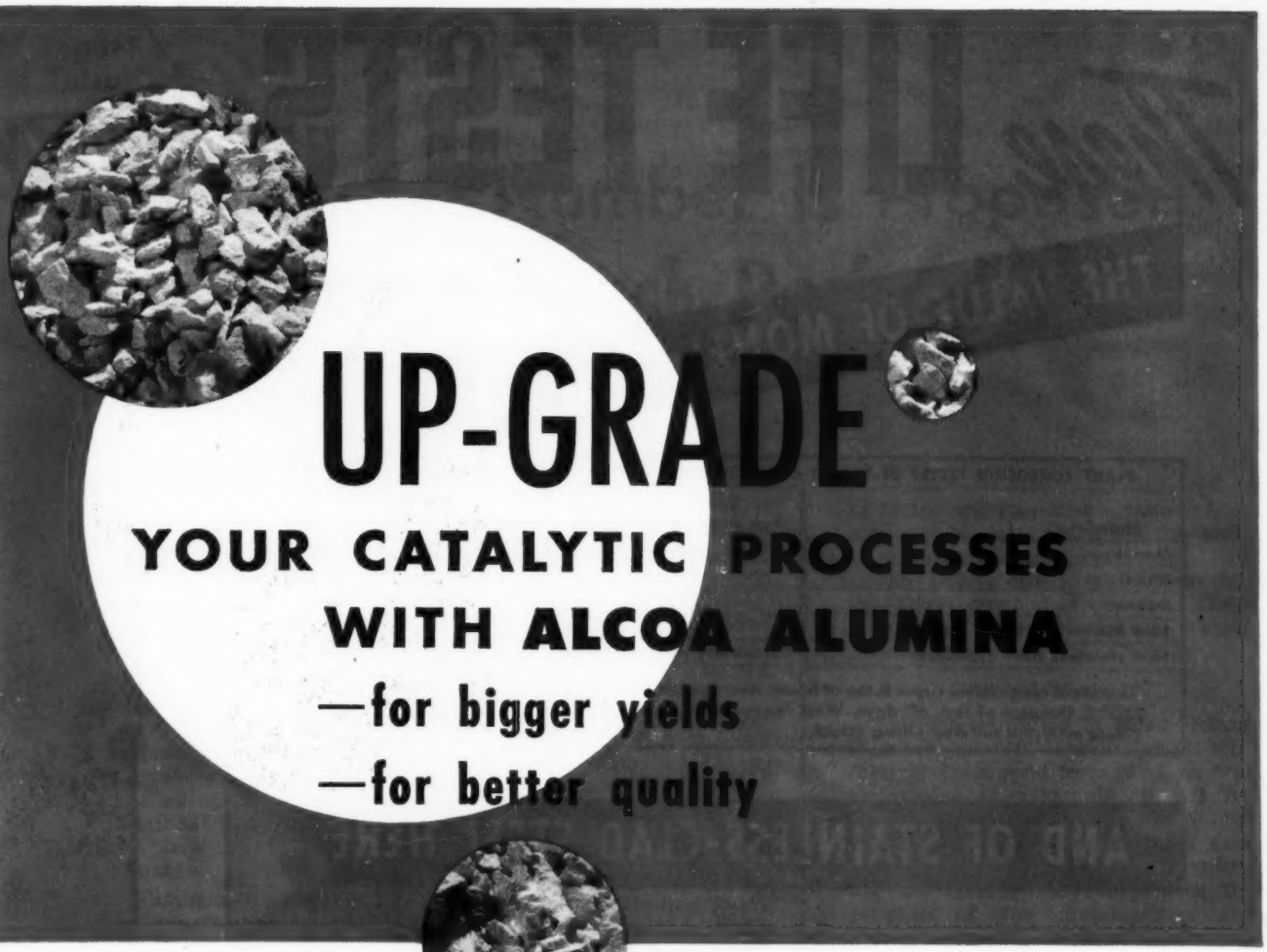


Fig. 3—Sinclair's shop-built laboratory freezer provides temperatures as low as −90° F.

WHEN technicians in the East Chicago refinery laboratory of Sinclair Refining Co. want to run extremely low temperature pour tests, they use a shop-built freezer, which will bring the temperature of the samples down as low as —90° F. if desired.

The unit is shown in plan and cross-section views in Fig. 3. It consists of a 2-gal. "thermos" jar with open top, supported on a metal cylinder to keep its bottom off the table, and an outer metal jacket for protection. Any desired number of holes are cut in the top plate to act as supports for the pour-test tube jackets.

A mixture of alcohol and dry ice put in the thermos jar is the cooling means. No mechanical agitator is required because the carbon dioxide provides natural agitation in bubbling through the alcohol.



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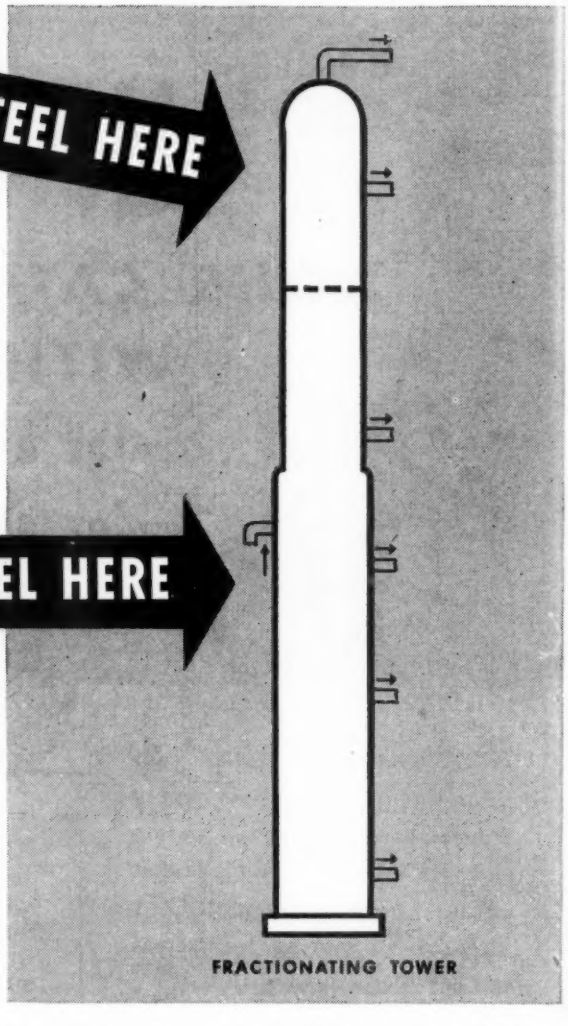
Material	Corrosion rate, inch penetration per year
Monel	0.003
Nickel	0.006†
Inconel	0.017†
18-8 Mo stainless steel (type 316)	0.053†
18-8 stainless steel (type 304)	Completely corroded away

*In straight run gasoline vapor in top of tower. Average temperature 250° F. Duration of test, 60 days. West Texas crude.
†These materials suffered pitting attack.

AND OF STAINLESS-CLAD STEEL HERE

PLANT CORROSION TESTS* IN BOTTOM OF CRUDE TOPPING TOWER	
Material	Corrosion rate, inch penetration per year
Monel	0.17
Nickel	Completely corroded away
Inconel	0.0002
18-8 Mo stainless steel (type 316)	Less than 0.0001
13 percent Cr steel (type 410)	0.0014

*At bottom of crude fractionating tower, approximately 5″ above tray No. 38 near the overflow side. Average temperature 700° F. Duration of test 120 days. East Texas crude. 88 gal. per hr. Na_2CO_3 injected into crude feed.



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Staff Report From Tulsa

Road Octane Number Is Proposed To Rate Anti-knock Performance

By D. P. THORNTON, Jr.
Assistant Editor

A METHOD for determining Road Octane Number of motor gasoline, and a method for predicting road anti-knock performance in the laboratory, were presented at the Fuels and Lubricants Meeting of the Society of Automotive Engineers, in Tulsa, Nov. 6-7.

The work discussed there represents a distinct advance in the development of techniques for evaluating the anti-knock characteristics of fuels, towards the eventual goal of providing test methods which will accurately predict how a fuel will perform in actual usage.

Road Octane Number, by fundamental definition, must "accurately reflect average consumer reaction to anti-knock characteristics of a fuel", and is thus distinguished from Motor and Research octane numbers, which are purely laboratory evaluations and at best are capable of only loose correlation with actual anti-knock performance in road vehicles.

Establishment of a sound method giving road octane ratings would facilitate the practical economic evaluation of the anti-knock characteristics of commercial motor gasolines and would be of great value to engine designers and motor fuel manufacturers.

Road Octane Number, as proposed in a paper by investigators for Shell Oil Co., Inc., is a single number based upon the well-established octane scale, which would reflect anti-knock performance in cars as a whole. It may be determined either directly by road testing or, indirectly, from correlation established with the laboratory Research Method (F-1) and Motor Method (F-2) octane numbers.

Also presented at the Tulsa meeting was a method developed in Pure Oil Co.'s automotive laboratory which uses a modified single-cylinder laboratory engine to predict road ratings directly. It is intended primarily as a screening medium for fuels in road test programs and fuel development work.

The method for expressing Road Octane Number for motor gasolines was given in a paper entitled "A Proposed Road Octane Number", by F. R. Watson, F. H. Caudel and J. D. Heldman, Shell Oil Co., Inc. The introduction lists what should be expected of a Road Octane Number.

"First, it should represent the anti-knock performance of a fuel insofar as the 'population' of cars is concerned"; it is stated, "that is, not one car or a few specific cars, but the entire group of consumer cars wherein lie our interests. Second, for most convenient use a one-number expression is desired, one that is numerically associated with anti-knock performance quality. Third, it should be built around a stable standard of anti-knock quality. Fourth, it should be capable of ready determination, directly by road testing and, if practicable, indirectly from correlation established with laboratory engine tests."

The proposed method has still other advantages as brought out in the paper. By means of correlating equations, the effects of fuel sensitivity on Road Octane Number can be obtained. By analyzing groups of cars of the same make, a quantitative measure of their individual peak octane requirements can be had, as well as the speeds for these peaks. Likewise, the differences in fuel requirements between makes of cars can be studied. The relative effects of Motor and Research octane quality also can be determined for the same or differing makes of cars.

The test method is divided into the direct method, from road tests, and the indirect method, from laboratory octane ratings.

Direct Method

The determination of Road Octane Number, hereafter designated "RON," directly from road tests involves first the choice of a sample of cars for the test. The number, age group, proportion by various makes and geographical location of cars constituting the sample may vary with the purpose of the investigation and therefore should be flexible. Second, the method of test should be decided upon and for this purpose the Borderline Method (CRC E-1) with minor modifications has proven satisfactory. Third factor is the fuels to be rated for knock or no-knock (the reference fuels—blends of i-octane and n-hexane— are made up in increments of five octane numbers or less). In each car the simple determination is made for each reference fuel and each gasoline under test: Is it knock-free or does it knock.

When testing is completed the RON is calculated for each gasoline as follows: The percent of knock-free cars is computed for each of the reference fuels and plotted vs. octane number, using arithmetic probability paper for convenience to obtain straight lines. Knowing the percent of knock-free cars for the gasoline, the reference fuel plot may be consulted to find the reference fuel octane number equivalent to that percent of knock-free cars. The value thus obtained is the Road Octane Number, i.e., the octane number of the primary reference fuel which gives knock-free performance in exactly the same percent of cars in general as does the gasoline.

Indirect Method

To obtain Road Octane Number indirectly from the laboratory F-1 and F-2 engine ratings, a practical correlation must first be found. A simple and direct method is to relate Road Octane Numbers to the corresponding laboratory methods by the use of em-

The accompanying article is a review of the following two papers presented at the SAE National Fuels and Lubricants Meeting at Tulsa, Nov. 4-5:

"A Proposed Road Octane Number", by F. R. Watson, F. H. Caudel and J. D. Heldman, Shell Oil Co., Inc.

"A Single Cylinder Laboratory Procedure to Predict Road Anti-Knock Performance", by F. T. Finnigan and E. M. Clancy, Jr., Research and Development Laboratories, Pure Oil Co.

Readers may secure preprints of the complete papers by writing Special Publications Dept., Society of Automotive Engineers, 29 West 39th St., New York 18, N. Y.

pirical equations. Assuming that F-1 (Research) and F-2 (Motor) ratings, taken together, correlate with road octane, the relationship is;

$$RON = A(F\text{-}1) + B(F\text{-}2) \quad \ldots . (1)$$

Here the coefficients "A" and "B" represent the influence of the two laboratory ratings on the known Road Octane Number and where, by definition, RON also is equivalent to either F-1 or F-2 quality, which assumes that A + B = 1. This permits simplification, Equation 1 being rewritten as:

$$RON = A(F\text{-}1) + (1\text{-}A)(F\text{-}2) \quad (2)$$

Equation 2 is the simplest of the possible equations relating F-1, F-2 and Road Octane Numbers. It has been found to satisfactorily correlate a substantial body of data and is the basis for the following discussion. Actually, experience would indicate that a more complex relationship would actually be justified on the basis of considerably more data than is now available.

The most probable value of "A" can be found by the method of least squares, shown in Equation 3, where "w" is the weight assigned the data for each gasoline tested and is numerically equal to the square root of the number of cars in which each gasoline was tested.

$$A = \frac{\Sigma w(F\text{-}2)^2 + \Sigma w(F\text{-}1)(RON) - \Sigma w(F\text{-}1)(F\text{-}2) - \Sigma w(F\text{-}2)(RON)}{\Sigma w(F\text{-}1)^2 - 2\Sigma w(F\text{-}1)(F\text{-}2) + \Sigma w(F\text{-}2)^2} \quad \ldots . (3)$$

Practical Application

These methods for obtaining Road Octane Numbers were applied to a recent West Coast octane requirement survey made by Shell, in which 220 cars were used. Models ranged from 1940 to 1947. Five commercial gasolines having sensitivities ranging from 5.5 to 8.5 were run in 148 of the cars, two commercial gasolines with a sensitivity of 12.5 were tested in 34 cars and the primary reference fuels in all cars. The criteria used in the investigation—no knock over the speed range of 500 to 3000 rpm—are believed to be both conservative and precise. The percent of knock-free cars was plotted against octane number as shown in Fig. 1, for all cars in the speed range of 500 to 3000 rpm (10 to 60 mph). This indicates the peak octane requirement followed the normal distribution curve; 99% of the cars tested are knock-free with 97 octane reference fuel, for example.

To determine RON, using Fig. 1 as a basis, the percent knock-free cars was calculated for each gasoline and a Road Octane Number assigned as shown graphically in Fig. 2. The least squares solution (Equation 3) yielded the correlation equation:

$$RON = 0.54(F\text{-}1)) + 0.46(F\text{-}2)$$

It is thus shown that when cars in general are tested, both "F-1 quality" and "F-2 quality" affect road antiknock performance; if either are altered, road octane is changed accordingly. This relationship provides a practical method of predicting antiknock quality of a gasoline when Research and Motor octane ratings are known. It also follows that RON and laboratory ratings can be expressed in terms of fuel sensitivity "S", when coefficients "A" and "B" of Equation 1 are known. For example, using the survey test data,

$$RON = (F\text{-}2) + 0.54\ (S)$$

and

$$RON = (F\text{-}1) + 0.46(S)$$

From these last two equations the gasoline having the highest sensitivity will give the greatest overall percentage of knock-free cars when comparing gasolines of the same F-2 rating. Likewise, in comparing those having the same F-1 rating, the one having the lowest sensitivity will give the greatest overall percentage of knock-free cars.

Such correlations can also be made to show octane requirements of the same or different makes, the speeds for peak octane requirements and the like.

"It may be concluded", states the Shell Oil Co. paper, "that the antiknock performance of a gasoline, insofar as cars in general are concerned, may be adequately described in terms of an equivalent blend of iso-octane and normal-heptane; that is, equivalent in the sense of giving knock-free performance in exactly the same percent of cars in general on the road.

"A nomograph (Fig. 3) relates the RON and the Percent of Knock-free Cars with the laboratory F-1 and F-2 octane numbers. Certain cars are generally critical to 'F-1 quality'

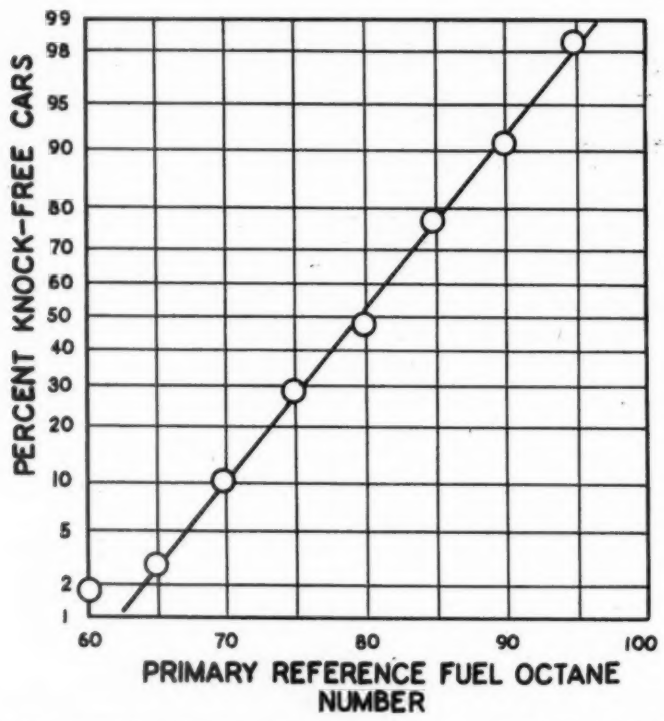

Fig. 1—Plot of percent knock-free cars vs. reference fuel octane number follows normal distribution curve

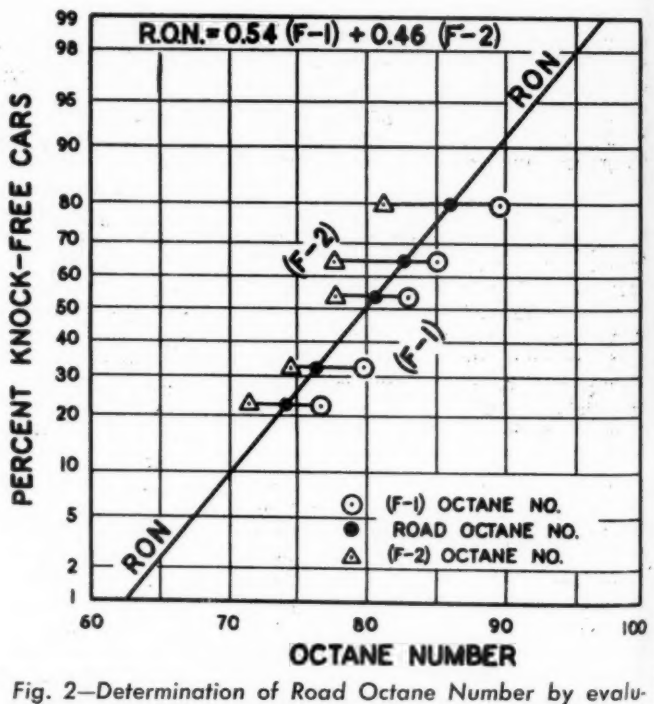

Fig. 2—Determination of Road Octane Number by evaluating respective effects of Research and Motor method quality. Data shows percent knock-free cars for 5 gasolines in 148 cars

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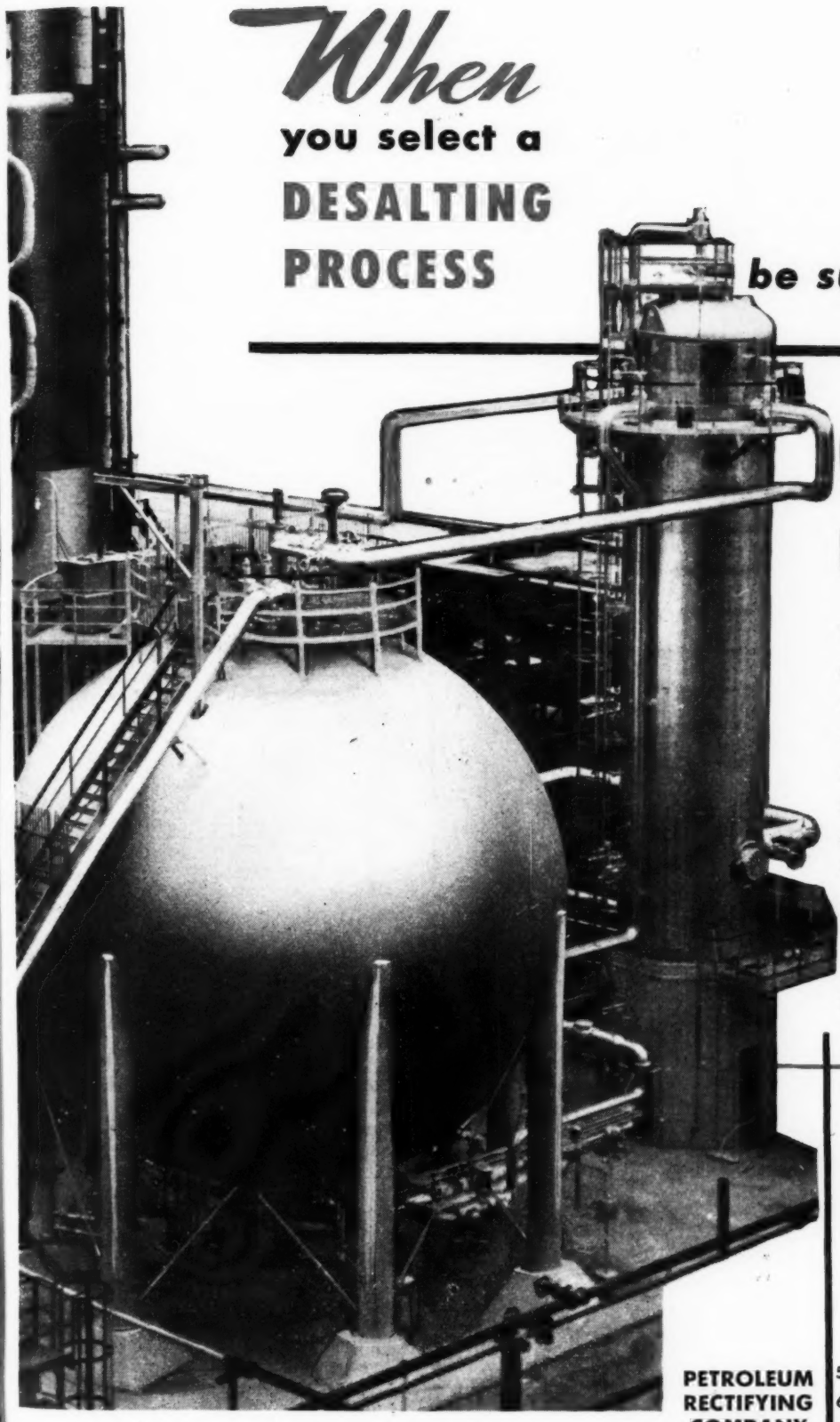

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and relatively unaffected by the 'F-2 quality' of a gasoline; with other cars, the converse is true.

"By clearly revealing these phenomena, the engine designer may be assisted in tailoring his engine antiknock requirements to gasolines, and the gasoline manufacturer may be assisted in tailoring his motor gasolines to the needs of his customers' cars. The methods herein described, while discussed strictly from the passenger car standpoint, may of course be applied likewise to commercial vehicles."

TABLE 1—Correlation Between Borderline Octane Rating and Laboratory CFR Engine Data

Fuel: (A) Buick		
Speed RPM:	Borderline	CFR-X
750	...	81.5
1000	81.0	81.5
1500	80.5	82.0
2000	81.5	82.0
2500	82.5	82.5

Fuel: (B) Buick		
Speed RPM:	Borderline	CFR-X
750	...	85.5
1000	85.5	85.5
1500	87.5	86.5
2000	86.5	86.0
2500	84.5	84.5

Fuel: (C) Buick		
Speed RPM:	Borderline	CFR-X
750	...	84.0
1000	83.0	84.0
1500	84.5	84.5
2000	84.5	84.5
2500	82.5	83.5

Fuel: (D) Buick		
Speed RPM:	Borderline	CFR-X
750	...	84.0
1000	85.0	84.0
1500	84.5	83.5
2000	83.0	83.0
2500	82.0	82.0

New "Lab" Octane Rating Method

Recent work in developing a laboratory octane rating technique which will correlate with the road antiknock performance of a gasoline was reported to the SAE Fuels and Lubricants meeting in Tulsa, in a paper by F. T. Finnigan and E. M. Clancy, Jr., Research and Development Laboratories, Pure Oil Co. The paper, entitled "A Single Cylinder Laboratory Procedure to Predict Road Anti-Knock Performance", describes the use of a modified CFR single cylinder engine for this purpose. The test was developed primarily as a screening tool for experimental fuels which would give valid results on small samples and be independent of weather or other difficulties encountered in road testing.

A conventional CFR engine was equipped with a high-speed crankcase, high lift camshaft, an aluminum piston and coupled to a 25 Hp. eddy-current type dynamometer. The usual CFR ice tower was used with an aviation test method manifold and fuel injector. Knocking was determined by oscillograph from a magnetic pressure-type pickup installed in the bouncing-pin hole.

An adequate supply of test fuels was available, all of which had previously been road-tested by the Borderline method.

Air-fuel ratio was set at 10:1 with the engine operating at 1000 rpm on 80 octane primary reference fuel; this setting is not changed throughout the speed range during a test, but may be varied as necessary to offset uncontrolled atmospheric changes. Air-fuel ratio was determined by an exhaust gas analyzer.

Additional operating standards selected include: intake air temperature setting maintained at 180° F. at 750 and 1000 rpm and allowed to vary naturally at higher speeds (temperatures range down to 110° F. at 2750 rpm); oil sump temperature maintained at 150±5° F.; tappet clearance (hot) 0.010 in.; spark plug gap 0.022 in.; water jacket temperature 210±2° F., and injection pump pressure 20 psig.

To obtain data on a broader scope, so that operating conditions more nearly like those on the road could be incorporated in the laboratory procedure, a road test program was inaugurated after the laboratory work had been carried on for a year. The road test program included running a 1947 Buick Roadmaster for road testing fuels and a 1946 Chevrolet for air/fuel ratio and intake manifold mixture temperature data.

A consolidation of conditions brought to light by the road test program were incorporated, resulting in a single cylinder laboratory fuel test procedure that has proved capable of foretelling the road octane values of a fuel to within favorable limits throughout a range of speeds and compression ratios.

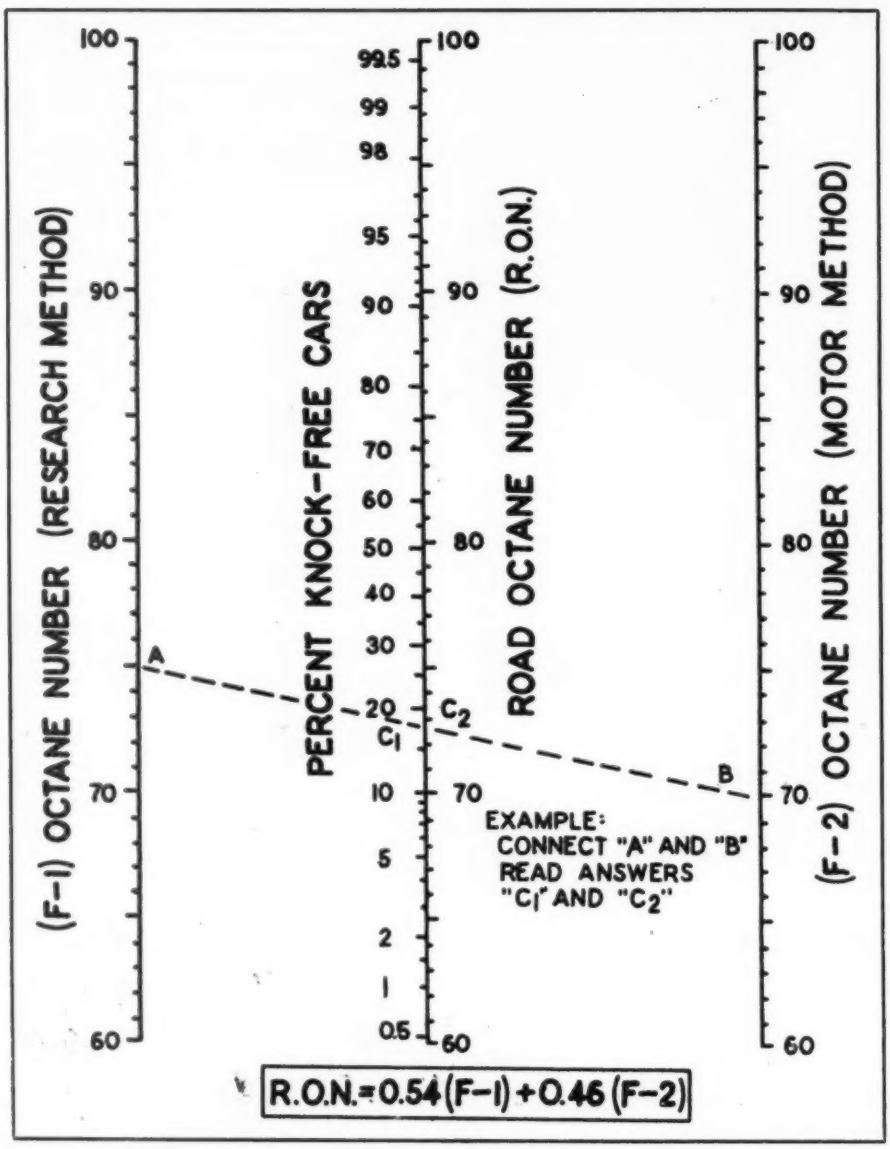
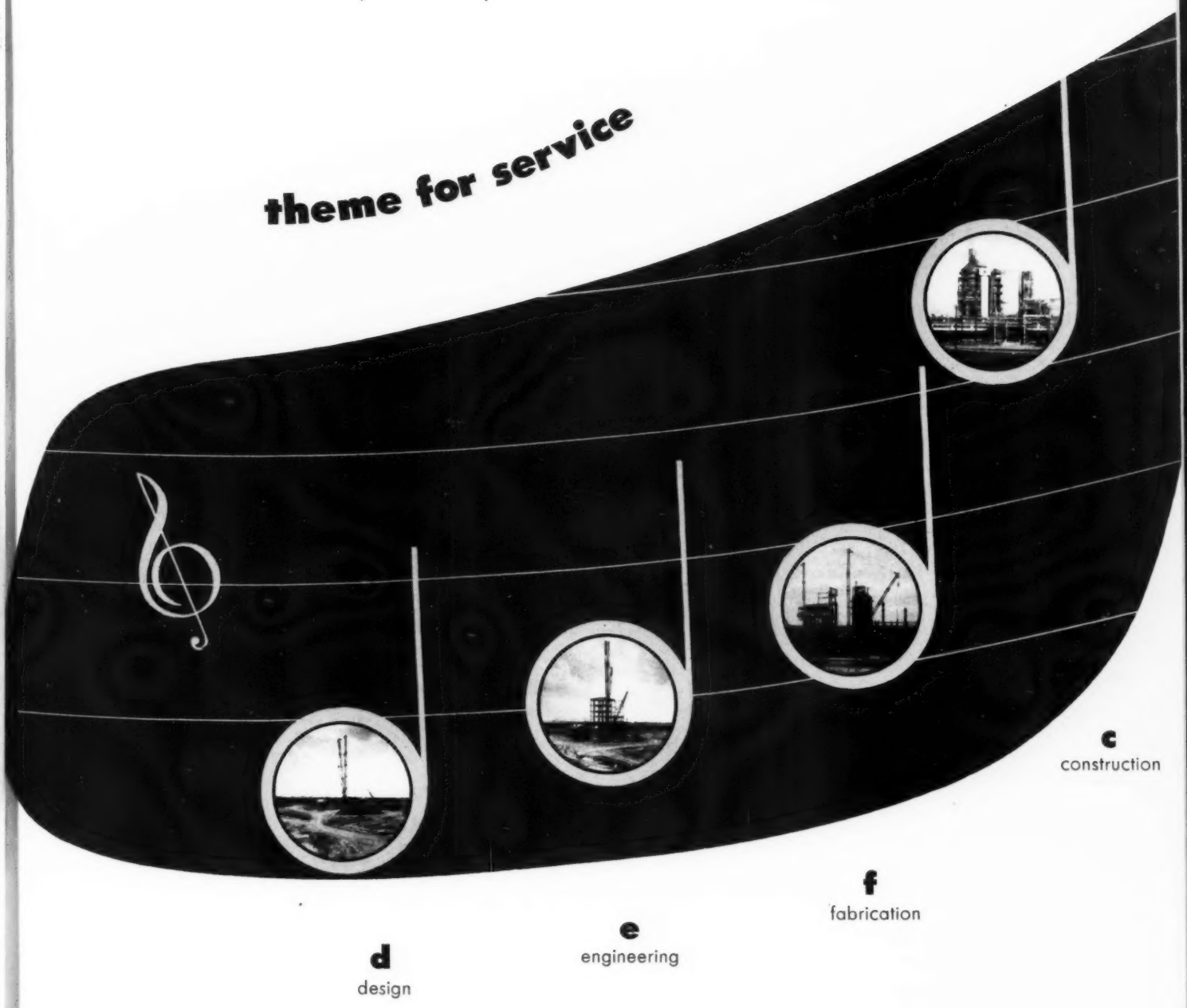


Fig. 3—Nomograph for predicting Road Octane Number and percent knock-free cars



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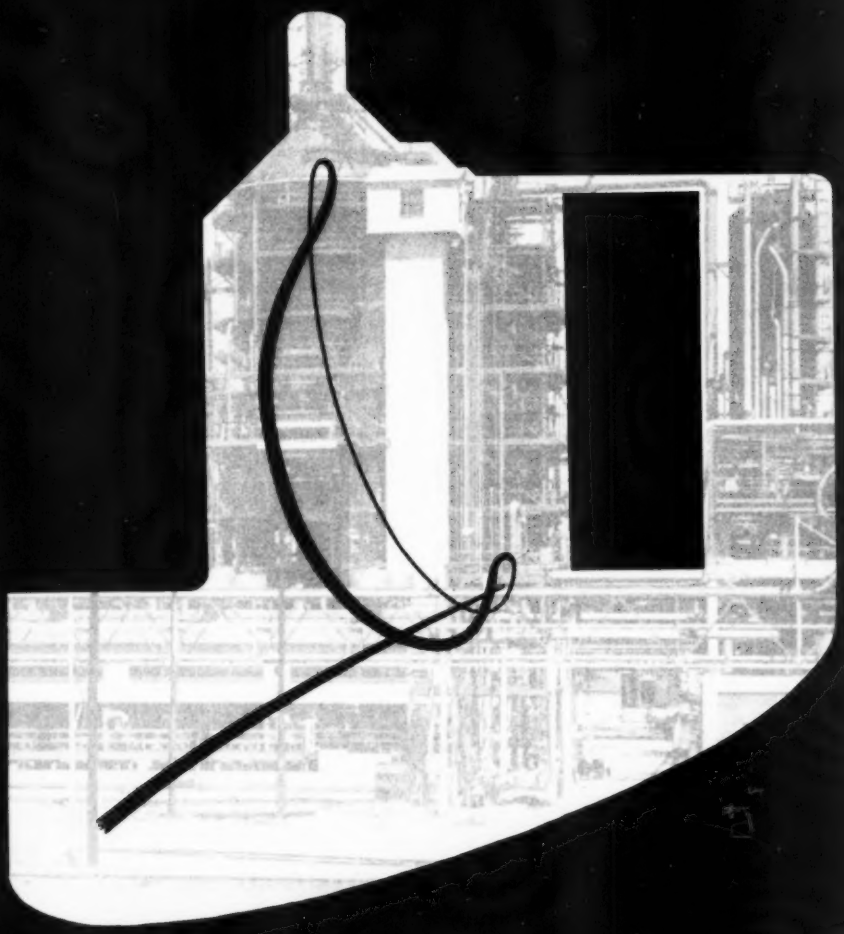
process rhythm



A smooth-running unit — a unit in balance — is one in which all parts are functioning in rhythm. This is possible only when the unit is designed 'right' and built 'right'.

Rhythm (as symbolized by the catalyst flow pattern in the illustration) is an achievement peculiar to the experienced professional . . . to the experienced contractor who knows just what qualities in the basic functions of design, engineering, fabrication and construction produce "process rhythm".

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THE outside installation of processing units in modern refineries has the advantages of eliminating building construction, providing more flexibility in locating production units in the desired sequence and making easier the dissipation of corrosive and noxious fumes. It is also said to reduce operation and maintenance costs as much as 15% in some instances.

The unhoused plants, however, bring up new problems in equipment design, installation and maintenance. Fluctuating ambient temperatures, ice formation, wind-borne solids and moisture, and sunlight, create new heat balance problems for design engineers and plant operators. Greater attention must be given also to the insulation which covers and protects the processing equipment and thus makes possible the closer control of reaction temperatures.

The two most important factors in outdoor insulation, in addition to the basic considerations of cost, ease of application and thermal conductivity, are mechanical strength and reaction to moisture. Much attention has been given recently to insulating materials produced from blown fibers of inorganic silicates, generally known as mineral wool, as providing the desired characteristics for outdoor applications.

These materials are strong, light, inorganic, and easy to install and maintain. Their thermal conductivities ("k" factors from 0.19 to 0.33 Btu in. per sq. ft., hr., deg. F. at ordinary mean temperatures) make them superior for insulating purposes. Further, they are supplied in a wide variety of forms, rigid block, pliable felt, blankets sandwiched between metal lath or poultry netting, loose wadding, granulated fill, and troweling cements. Molded forms are made for standard sizes of piping up to 14-in. and for use on common types of fittings.

In addition, helpful and thoroughgoing standards for the materials have been drawn up by the National Bureau of Standards to insure manufacturer compliance with minimum quality requirements and to instruct users in the proper installation techniques for different conditions. These standards, CS-117 and CS-105 are widely available and should be studied by all users and appliers of insulation for industrial purposes. Standard CS-117 covers the insulation of heated surfaces, Standard CS-105, cold surfaces.

Moisture is prevented from getting into the insulation by applying it over surfaces hot-mopped with asphaltic compounds, and by encasing insulation layers in non-porous membranes of impregnated canvas, special felts, or weather resisting paints. External surfaces are often rendered structurally strong and hard by troweling mineral wool cements over expanded metal lath and weatherproofing with asphaltic, roofing-felt, or other finishes; or by encasing the whole job in sheet metal, crimped, riveted or seam welded in place.

Danger of damage from moisture condensation inside insulation is twofold: equipment corrosion and the filling of insulation dead-air spaces with water or ice of high thermal conductivity. To prevent this moisture condensation, vapor barriers (usually an asphaltic emulsion) are employed. Their application is an important step and must not be neglected, regardless of the type of insulation used.

The following article gives installa-

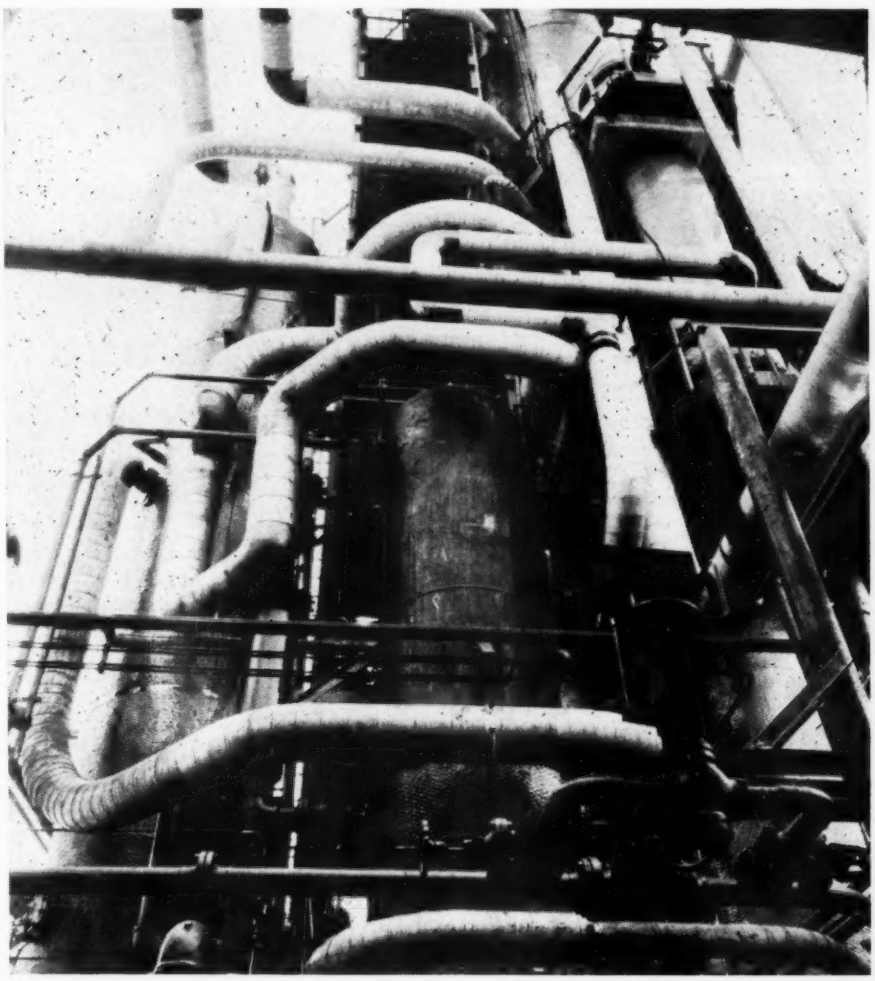

Fig. 1—Insulation of piping maintains temperature of products during transfer from one piece of equipment to another

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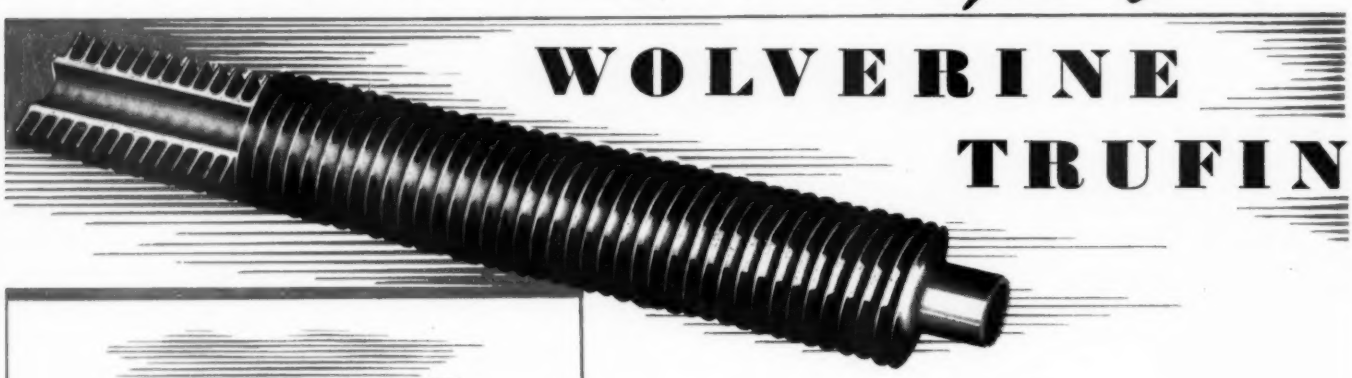

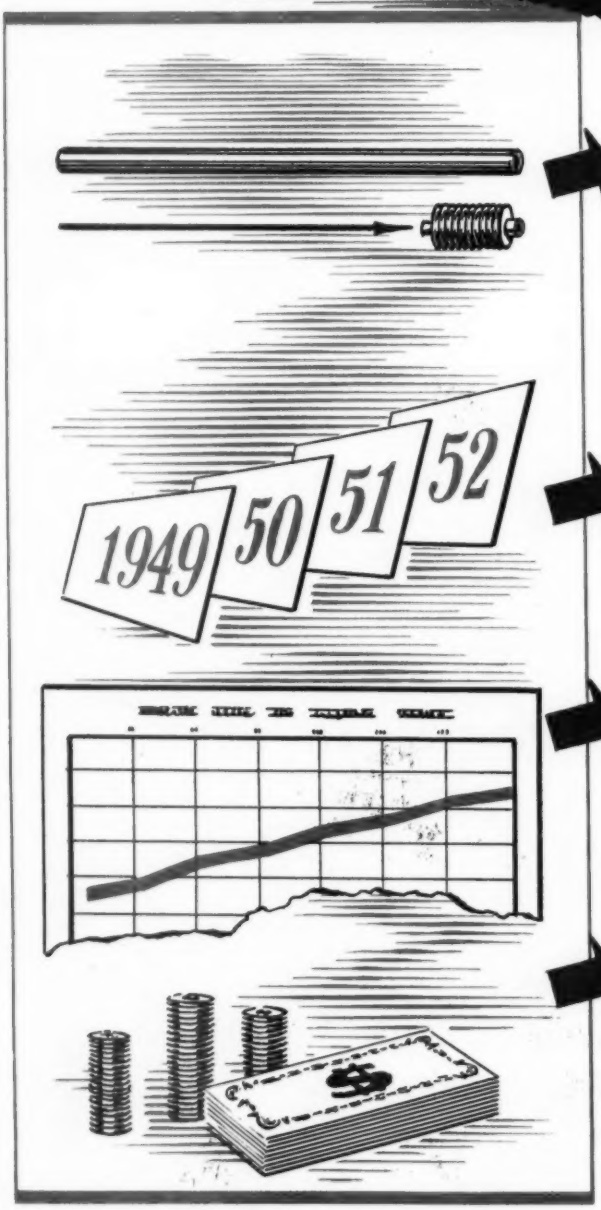

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tion techniques for installing mineral wool insulation on four common types of petroleum processing equipment, pipes, tanks, ducts, and flanges.

Piping

Fig. 1 shows a portion of a maze of piping such as is a requisite of processing unit installations.

These pipes are the connections between processing equipment and its supply units, other processing equipment, storage tanks, or shipping conveyances. Unless the piping is as well insulated as the major refinery units, carefully processed products will lose heat and will require extra heat to bring them back to the same condition as when they left the processing unit.

In insulating pipes, two general methods are employed. Molded-type mineral wool pipe insulation is available for ½ to 14-in. pipes. Sections are 36 in. long and are fitted over the pipe, covered with a canvas jacket or other specified finish, and bound in place with metal bands. In some cases, double-layer pipe insulation is used. The first layer is bound in place with galvanized wire and the second layer applied as above, its joints staggered with those of the sections in the first layer.

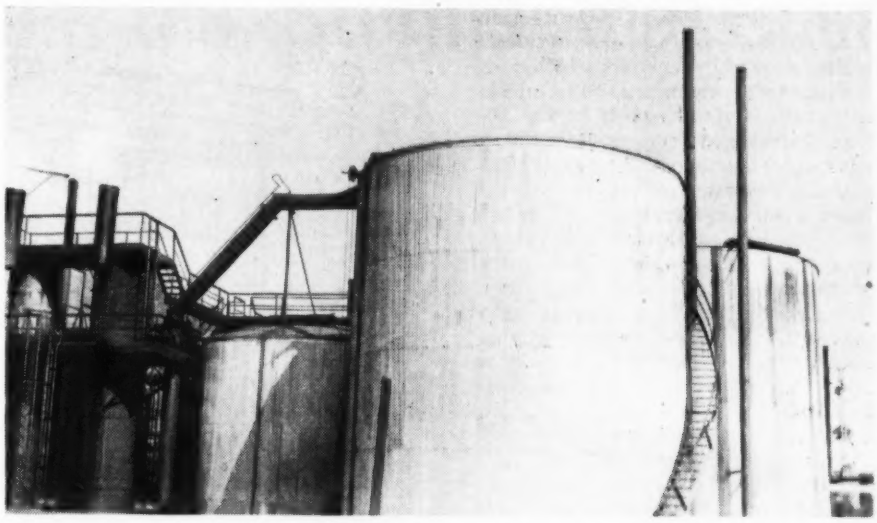


Fig. 2—Asphalt oxidizing tanks insulated with 2-in. blanket of mineral wool, the mineral wool being protected by a 20-gage sheet metal outer shell

A second common method of insulating pipes is with mineral wool blanket-type insulation. Blankets are wrapped circumferentially around the pipe, joints are secured with 16-gauge galvanized wire, a coating of mineral wool cement is applied, and finally an asphaltic or other specified finish is applied. Roofing felt, bound in place by galvanized wire with seams lapped at least two inches against the weather, is a common finish.

Processing Tanks

Fig. 2 shows a group of four asphalt oxidizing tanks, two of 1500 and two of 5000-bbl. capacity. Asphaltic bases are heated and oxidized in these tanks at temperatures ranging from 350° F. to 500° F. The oxidizers are insulated to minimize localized overheating or underheating, to make possible close control of temperature limits in maintaining quality control of the product, and to reduce the quantity of fuel required for carrying out the oxidizing cycles. The danger of flashing or firing when 500° F. is exceeded is one of the strongest reasons in this operation for careful heat distribution and control. Insulation permits control up to the maximum reaction heat without fear of over-ride.

The oxidizers are insulated with 2-in.-thick mineral wool blankets. The wool is sandwiched between poultry wire on one side (in contact with the ¼-in. steel plate of the tank) and expanded metal lath on the outside. The blankets are held in place by heavy wires spot welded perpendicularly to the steel plate prior to application of the insulation. The blankets are impaled on the wires, and ends of which are then bent up and clinched to the lath backing. All joints of adjacent blankets are securely wired together at

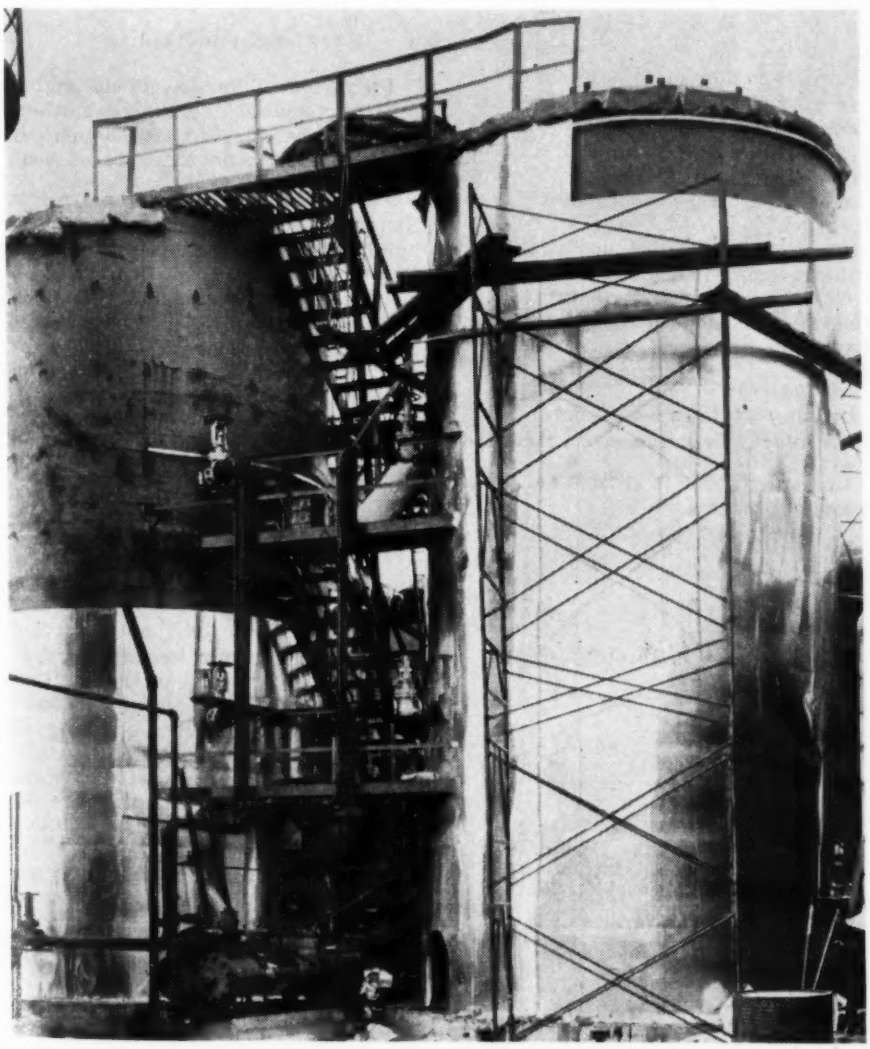


Fig. 3—Asphalt tanks insulated by stuffing mineral wool between tank and aluminum sheeting

the lath edges. Weather protection and moisture sealing are obtained simultaneously by the application of a corrugated, galvanized, sheet-metal outer shell. Riveted seams of the 20-gauge galvanized iron shell make a strong outer surface and prevent penetration of water or other harmful atmospheric constituents.

The exhaust gases and smothering steam from the asphalt tanks are withdrawn and passed through two fume absorbing towers. Coke is used in these towers to absorb the noxious, corrosive waste gases for health protection, and the remaining non-condensed steam is allowed to vent to the atmosphere. The use of insulation on these units helps to hold the oxidation temperature constant and thus keeps the cycle time at a minimum.

In another instance of insulation of asphalt tanks, Fig. 3, lugs were attached to the tank surfaces, aluminum plates were fastened to the lugs and loose mineral wool was stuffed between the plates and the tank at each rise of the plates. Blanket type mineral wool was used in insulating the tops of the tanks. Thickness of the application is three inches.

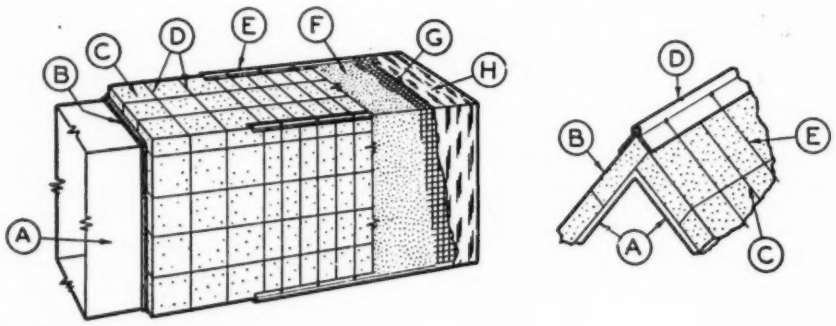


Fig. 4—

Left—A, bare surface; B, stiffener ribs; C, mineral wool blocks; D, No. 16-gage galvanized reinforcing wires or ½-in. galvanized bands applied over blocks; E, corner bead secured over blocks at corners with No. 16-gage galvanized wires; F, insulating cement; G, 1-in. galvanized wire netting stretched tightly over insulating cement and wired in place; H, finishing cement or asphaltic finish.

Right—Enlarged details showing application of corner bead. A, metal duct; B, mineral wool blocks; C, No. 16-gage galvanized wire over blocks; D; corner bead; E, No. 16-gage galvanized wires drawn through perforations in corner bead.

Ducts

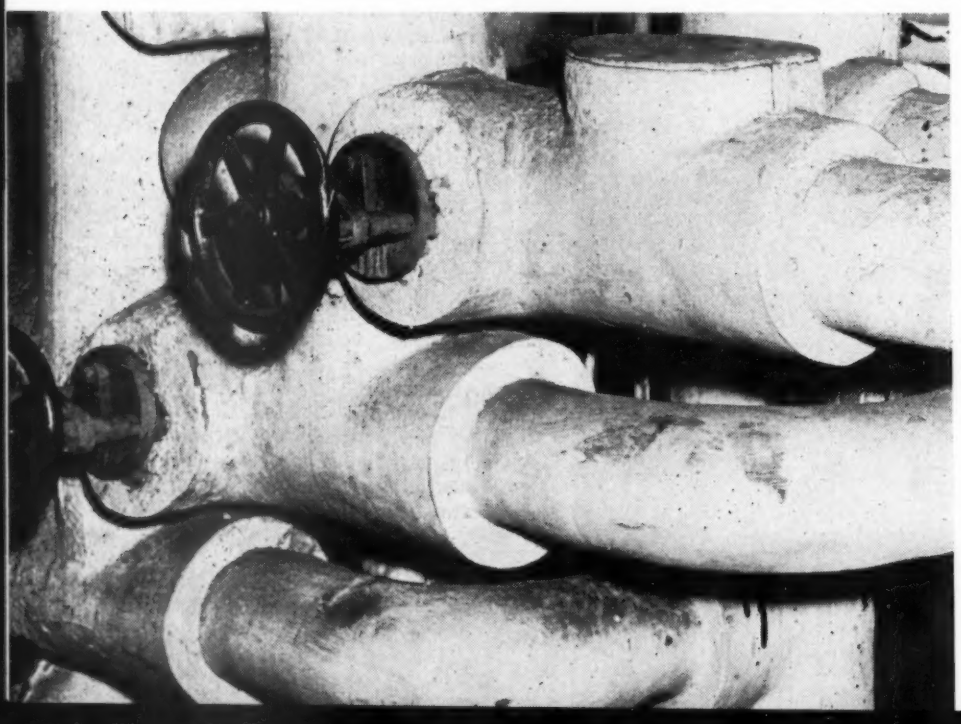
The insulation of ducting is another important factor in outside refinery construction. In insulating ducting and breechings, the block form of mineral wool is generally employed. Commercial Standards CS-117 "Mineral Wool; Blankets, Blocks, Insulating Cement, and Pipe Insulation For Heated Industrial Equipment," recommends that ducting be insulated as shown in Fig. 4.

The following example gives a definite indication of fuel savings which can be effected by proper insulating techniques. Assume a duct operating at 620° F. having 700 sq. ft. of surface area. Assume also a 2½-in. covering of insulation.

Bare heat loss—2700 Btu x 700 sq. ft. x 24 x 365 = 16,556,400,000 Btu per year
(Kent Page 3-64)
Insulated loss—113 Btu x 700 sq. ft. x 24 x 365=692,916,000 Btu per year
(Kent Page 3-67)
Subtracting: 16,556,400,000−692,916,000=a saving of 15,863,484,000 per year.

Assuming the use of oil fuel having 145,000 Btu per gallon and an operating efficiency of 60%, the saving is equivalent to 182,339 gals. of oil per year.

Fig. 5—Flanges and valves are insulated by building up layers of mineral wool cement or by cutting and fitting mineral wool blocks to conform to the surface area



Flanges and Valves

Flanges and valves should not be left uninsulated for they represent a large total surface area which can waste considerable amounts of heat.

Two techniques are often used in flange insulation. They are: (1) building up the odd shaped connection with mineral wool insulating cement in ¾-in. layers and then finishing off as the other insulated equipment is finished, and (2) by notching and cutting mineral wool blocks to fit the contour of the odd shaped equipment, wiring them in place, and applying insulating cement and specified finishing. Fig. 5 is a typical installation of flange and valve insulation.

The foregoing cases are typical in the petroleum field. Each job, of course, poses its own difficulties which must be solved by the plant superintendent. For example, thicknesses vary according to temperature differentials. Recommended thicknesses are found in engineering handbooks and in Government Standards (CS-117 and CS-105). Repairs present problems calling for maintenance department ingenuity. If the insulation is properly installed, there will be no breakdown; however, it frequently becomes necessary to remove insulation to reach and repair equipment underneath. This is simple where mineral wool is used since sections of blanketing or blocks are easily cut away without damaging surrounding insulation. The same insulation is then replaced and coated with cement for continued service.

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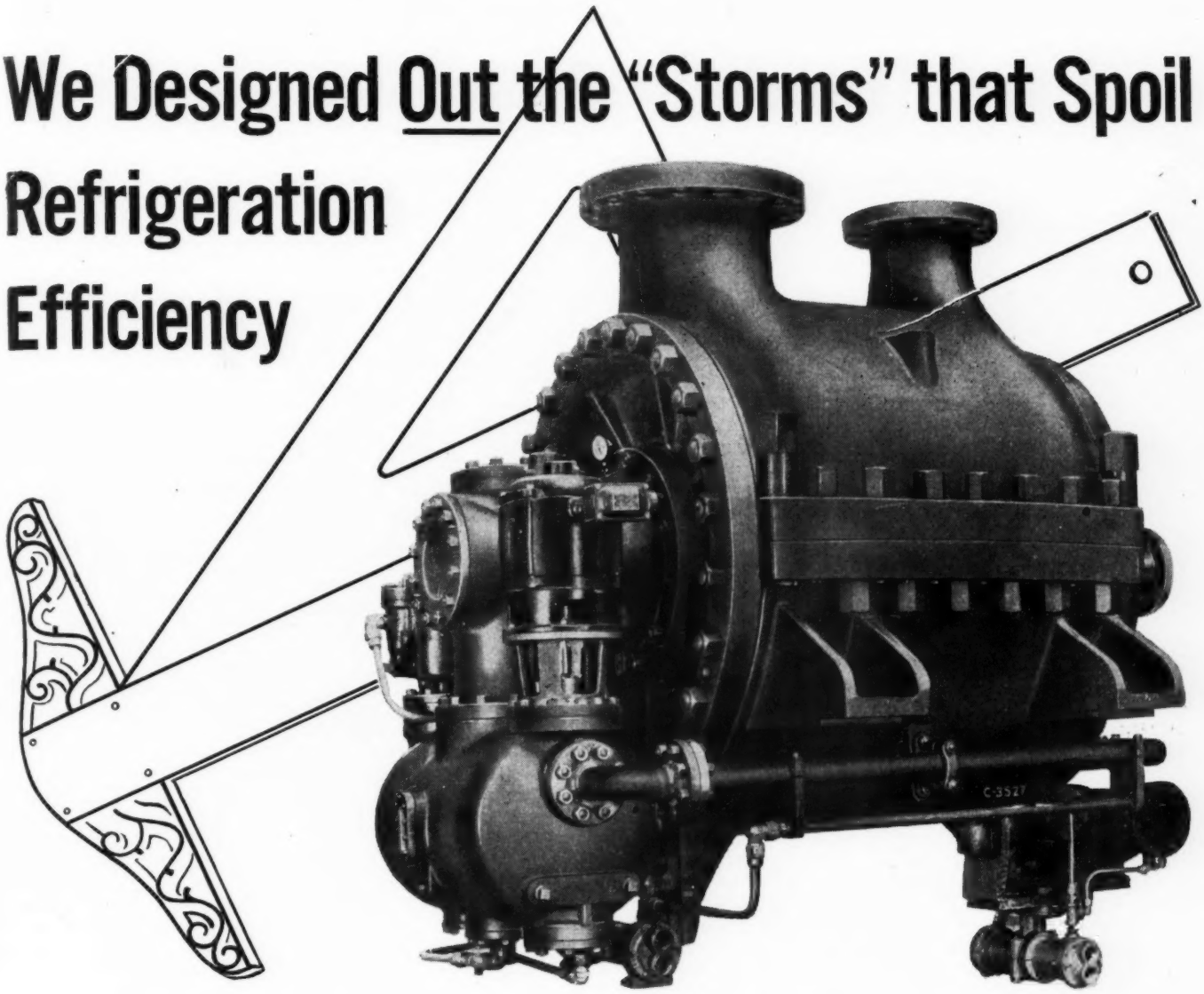

The use of "twin volutes" in the design of the Worthington Centrifugal Compressor provides greater efficiency and stability of operation at system design point and partial loads. This is due to the compressor's inherent head-capacity curve flexibility from 120% of full load to 40% of full load capacity without bypass or gas make-up.

Compressors are manufactured to handle loads at single temperature levels or multiple loads at different temperature levels. These loads may be injected between various stages of compression to suit tower levels and through-put.

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Worthington Centrifugal Compressors are designed to use any hydro-carbon refrigerant, such as methane, propane, propene, ethane, ethene, isobutane, normal butane, butene and plant mixtures . . . to handle capacities from 1500 to 60,000 cfm, in one unit, at temperature levels from minus 200F to plus 60F and pressures from 100 to 400 psi . . . to be driven by motor, steam turbine, gas or Diesel engine. Casings are made of cast iron, cast steel or nickel steel.

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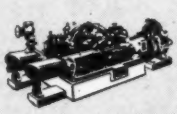
WORTHINGTON

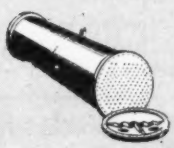
AB.35

FIVE MORE REASONS WHY WORTHINGTON LEADS IN INDUSTRIAL REFRIGERATION

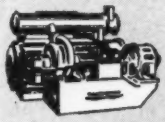
Horizontal compressors for all types of refrigerants



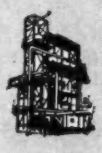
Shell and tube refrigerating equipment



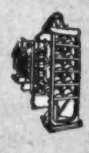
Centrifugal compressors



Absorption refrigerating machines



Chilling machines and exchangers



Patent Trends in Petroleum Refining

By PETER J. GAYLOR
Patent Attorney and Editor "The Technical Survey"

Vacuum Distillation Of Lubricating Oils

THE FUTILITY of bubble-tray fractionation in high vacuum systems is obvious when one considers that a 30 tray tower may consume one atmosphere of pressure in the form of resistance or back-pressure. Furthermore, ordinary commercially-available vacuum-producing steam jets do not give enough vacuum for best lube oil distillation.

According to Phillips Petroleum Co.'s patent 2,443,970, neutral oils are condensed in the chambers of an apparatus to make excellent circulating media and, when used with properly designed vacuum-producing jets, very low vacua may be obtained. A conventional 3-stage steam jet is used to obtain a vacuum of 757 mm. of mercury, or a residual absolute pressure of 3 mm. of mercury. This is supplemented with a series of properly designed oil-operated jets wherein pressures of 1/9 mm. of mercury or lower may be obtained. With such pressures, neutral oil constituents can be distilled from bright stocks at a temperature sufficiently low as to avoid much of the thermal decomposition or color formation usually encountered at higher pressures.

The process involved may be more readily followed by reference to Fig. 1 in which a horizontal vessel 10 is divided into five compartments 14, 23, 35, 46 and 74. The corresponding partitions 56, 57, and 58 are provided with venturi jets 13, 34, and 45 which are operated by condensed oils. Level controllers 18, 25, 37, 48 and 60 control the amount of liquid in the respective chambers, the liquid being designated by numerals 17, 24, 36, 47 and 61.

A feed, such as a long residuum D bright stock enters through line 11 and heat exchanger 12 and is sprayed into the first chamber 14 through nozzle 15. The final vapor outlet 73 is connected to a 3-stage steam-operated vacuum-producing jet which is not shown. Oil jet 45 operates to reduce the pressure in compartment 35 to about 1 mm. residual pressure, discharging into compartment 46. Likewise, jet 34 reduces pressure in compartment 23 to about 1/3 mm., while jet 13 reduces the pressure in compartment 14 to about 1/9 mm. The bright stock enters compartment 14 at about 500°-700°.

Neutral oils are distilled out of the feed in chamber 14 and the residual D bright stock is discharged through line 22 after passing through cooler 19, the flow being controlled by pump 20. Since the pressure in chamber 23 is higher than in 14, the compression liquefies higher boiling components of the vapors entering through venturi 13, and excess of this liquefied fraction is pumped out through line 32, as is the case with the liquid fractions from the other chambers, which are pumped out through lines 44, 55 and 67. Baffle plates 16, 26, 38 and 49 are installed to prevent entrainment.

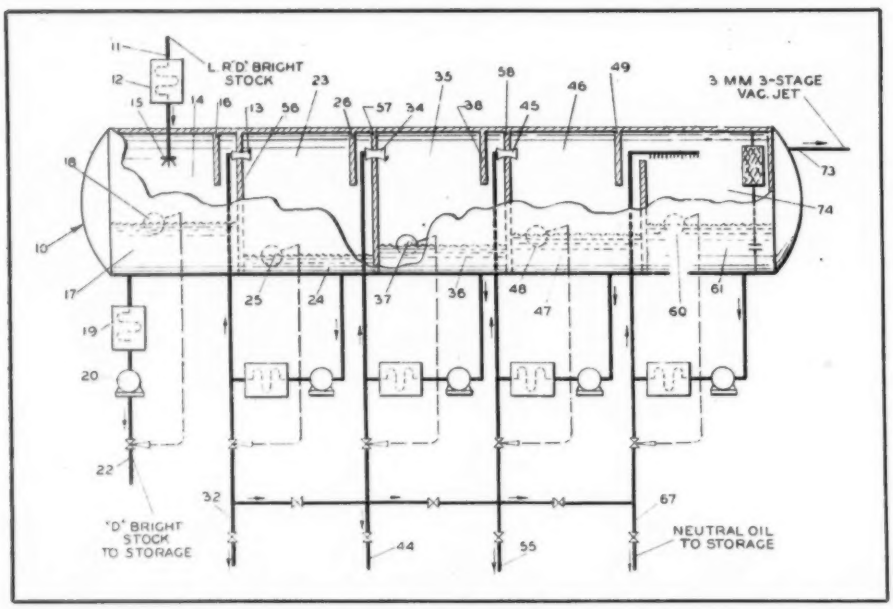


Fig. 1—Diagram of apparatus developed by Phillips Petroleum Co. for vacuum distillation of lubricating oils. (U.S. 2,443,970)

Antioxidants Improve Rust Preventives

IT IS WELL KNOWN that the addition of relatively high molecular weight polycarboxylic acids to lubricating oils imparts anti-corrosive properties to the oil, such acids being polymerized oleic acid, alkylene succinic acids, etc.(1) In its U.S. patent 2,442,672, Shell Development Co. finds that the addition of small amounts of antioxidants to these oils enhances the anti-corrosive properties considerably.

The effect obtained is shown graphically in Fig. 2. Curve 1 shows the neutralization number of a mineral oil of 150 Saybolt Universal viscosity at 100° F., as plotted against time of exposure to oxygen under a standard set of conditions. Curve 2 shows the same oil containing 0.01% of an alkyl phenol, while curve 3 shows the results with the same oil containing 0.01% alkyl phenol and 0.01% alkyl succinic acid. It is obvious that the acid enhances the effect of the phenol, although a blend of oil with acid alone could have been tested for antioxidant effect of the acid itself.

A similar type of effect has been shown in the Standard Oil Development patent 2,296,342 in which it was demonstrated that lubricating oils containing certain ester oiliness agents exhibited a considerably lower corrosion rate on copper-lead bearings when certain antioxidants such as benzidine or butyl oxalate, etc. were added to the blended oils.

Advantages Claimed for Hollow Spherical Catalysts

THE PRODUCTION of spherical catalysts has become a large scale operation, with firms such as Socony-Vacuum Oil Co. and Standard Oil Development Co. producing large quantities of the material. The subject has been discussed in this section previously.(2)

Recently, Socony-Vacuum was granted U. S. patent 2,449,253 which discloses the production of hollow gel spheroids, in contrast to the solid spheres previously produced. The process involves forming a hydrosol

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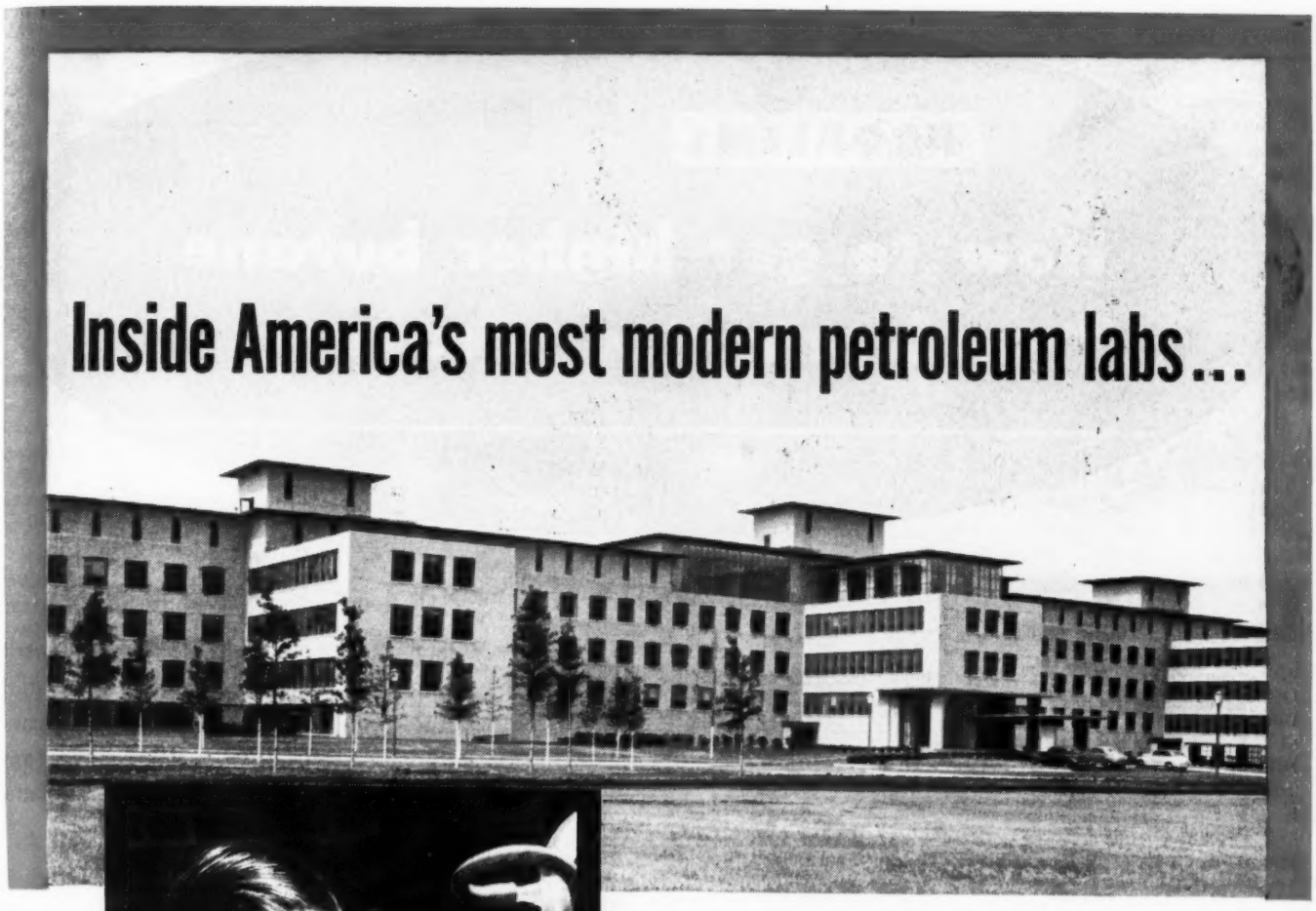

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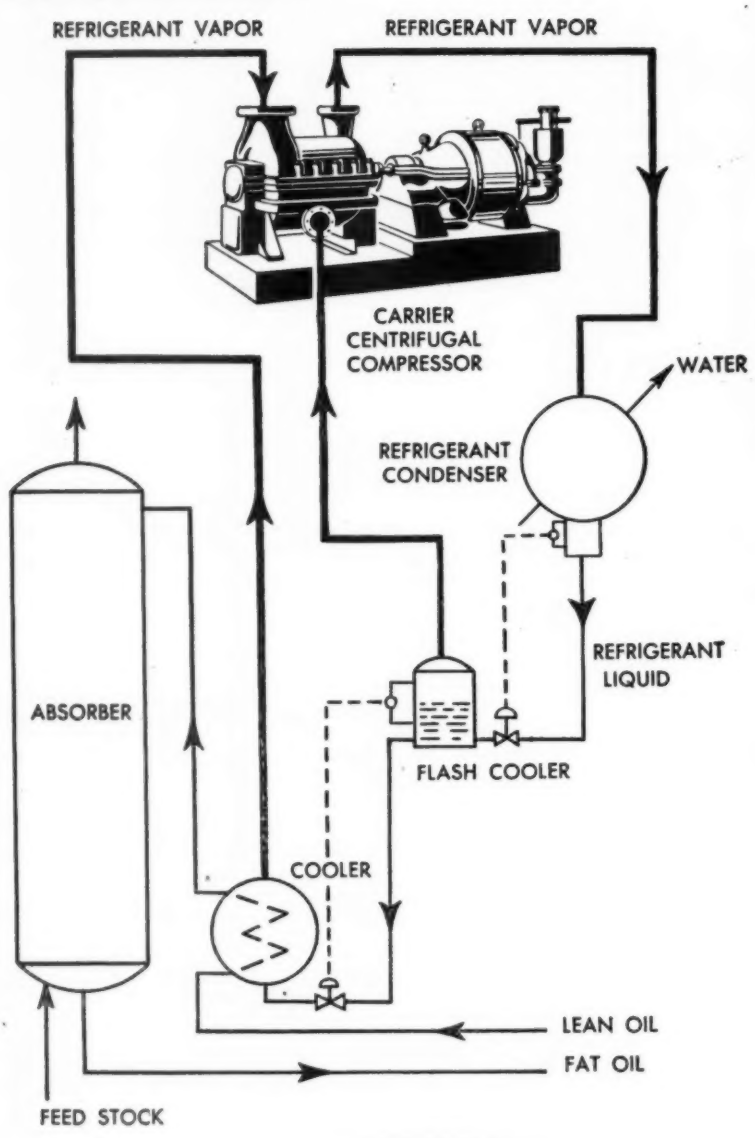

This diagram shows a typical use of Carrier Centrifugal Compressors with hydrocarbon refrigeration cycles as a solution for higher butane and propane recovery. This method has been proved efficient and economical in actual performance in refineries and natural gasoline plants.

Among the companies that have invested in Carrier Centrifugal Compressors for this purpose are La Gloria Corporation, Shell Oil Company, Warren Petroleum Corporation, and many others. They find that this refrigeration permits lower absorber pressure with savings in gas compression. It also reduces lean oil circulation, with corresponding economies in distillation and steam requirements for stripping. In many cases, sufficient steam is saved to power the turbine that drives the compressor.

Equally important, Carrier Centrifugal Compressors are ruggedly built to give dependable service year after year. Developed by Carrier engineers through more than a quarter-century of research and practical experience, they incorporate the latest refinements of centrifugal design.

Carrier, a pioneer in centrifugal refrigeration, has recently expanded its facilities to assure prompt delivery of its products, for which there is an ever-increasing demand. This demand is the result of one factor — outstanding performance in the field. Carrier Corporation, Syracuse, New York.

Carrier CENTRIFUGAL COMPRESSORS • REFRIGERATION EQUIPMENT

of inorganic oxide having the inherent properties of setting to a hydrogel without change in chemical composition after the lapse of a period of time, and of passing through a viscous state just prior to gelation. The viscous sol is injected, just prior to gelation, at a temperature in excess of its boiling point at the existing pressure, into a fluid medium maintained at a temperature in excess of the boiling point and at a pressure below the vapor pressure of the sol at the time of injection. When this is done, the water content of the hydrosol is vaporized, expanding the drops to hollow spheroids (as in the case of puffed wheat) which are gelled in that form.

One important result of such a process is the saving in catalyst material. Other advantages would be reduction in weight (which is important in moving catalyst processes) and possibly increase in effective surface area.

References

(1) Shell, U. S. pats 2,124,628 and 2,133,734.
(2) Gaylor, *National Petroleum News* 12/5/45, p. R-986; PETROLEUM PROCESSING 9/47, p. 701.

Other Recent Patents

Below are presented brief reviews of other process and product patents issued recently and of interest to petroleum processors.

Method of preparing lithium base greases, at temperatures attainable in a steam-jacketed kettle, which comprises saponifying with a basic lithium compound various blends of soap-forming fatty acids and combining with an oleaginous vehicle. U.S. 2,450,219-20 and 2,450,254-55; Harry V. Ashburn and Robert S. Barnett, to The Texas Co.

Shear-resistant greases consisting of a high molecular weight, high-boiling liquid aliphatic dicarboxylic acid ester and a metal or a lithium soap. U.S. 2,450,221-22; Harry V. Ashburn, Robert S. Barnett and Oney P. Puryear, to The Texas Co.

Preparation of barium soap greases comprising saponifying a soap-forming fatty acid and barium hydrate in the presence of a mineral oil. U.S. 2,450,224; Eric A. Bergmann, Harry V. Ashburn and George W. Eckert, to The Texas Co.

Process for a moldable plastic comprising a reaction product of 2-butene and sulfur dioxide using lithium nitrate as a catalyst. U.S. 2,450,424; Frederick E. Frey to Phillips Petroleum Co.

Producing aromatic nitriles by contacting various selected aromatic, paraffinic and olefinic hydrocarbons with ammonia gas in the presence of a molybdenum catalyst or a vanadium oxide catalyst. U.S. 2,450,632; Hamilton P. Caldwell, Jr., and Harold D. Chapman to Socony-Vacuum Oil Co., Inc. U.S. 2,450,636-42; William I. Denton and Richard B. Bishop to Socony-Vacuum Oil Co., Inc.

Obtaining alkyl benzenes from a petroleum oil where separation of the benzene and non-aromatics is not feasible by conventional distillation, by selective alkylation in the presence of aluminum chloride of the fraction boiling below 90° C., to alkylate only the benzene; fractionally distilling the mixture, the fraction above 90° C. being alkyl benzene substantially free of non-aromatic hydrocarbons. U.S. 2,450,652; Alfred W. Francis and Carleton H. Schlesman to Socony-Vacuum Oil Co., Inc.

Production of thiophene and other valuable organic compounds from selected C_4 hydrocarbons by separately preheating sulfur and the hydrocarbon fraction and reacting the preheated materials at from 850 F. to 1400 F. U.S. 2,450,658; Rowland C. Hansford and Herbert E. Rasmussen to Socony-Vacuum Oil Co., Inc.; U.S. 2,450,659; Hansford and Rasmussen and Alexander N. Sachanen, to Socony-Vacuum Oil Co., Inc.

Improvement in catalytic cracking, by reducing space velocity of hydrocarbons through catalyst bed by increasing volume of the bed as the average activity of the catalyst diminishes. U. S. 2,457,172; Herbert B. Willard to Gulf Oil Corp.

Process for first desulfurizing, then cracking, a sulfur stock in separate zones with the same catalyst, catalyst being withdrawn from the cracking zone for regeneration. U. S. 2,450,724; Henry W. Grote to Universal Oil Products Co.

Process for producing blown asphalts by air-blowing a high molecular weight petroleum hydrocarbon in the presence of a phosphorus catalyst. U. S. 2,450,756; Arnold John Hoiberg to Lion Oil Co.

Lube oil additive, a halogen-bearing synthetic material obtained by condensation of a homogeneously halogenated waxy ester with an anhydrous metal salt of a carboxylic acid. U.S. 2,449,547; Gordon D. Byrkit to Lubrizol Development Corp.

Butane isomerization process which includes passing the gaseous stream from the aluminum chloride reaction through a bed of treated charcoal for further conversion. U. S. 2,450,764; Charles O. Meyers to Phillips Petroleum Co.

Block grease consisting of mineral oil and a soap base comprising approximately equal quantities of a soap of a hydrogenated rosin and a fatty acid soap, and a diarylamine in an amount to inhibit oxidation. U.S. 2,450,149; Paul R. McCarthy to Gulf Research & Development Co.

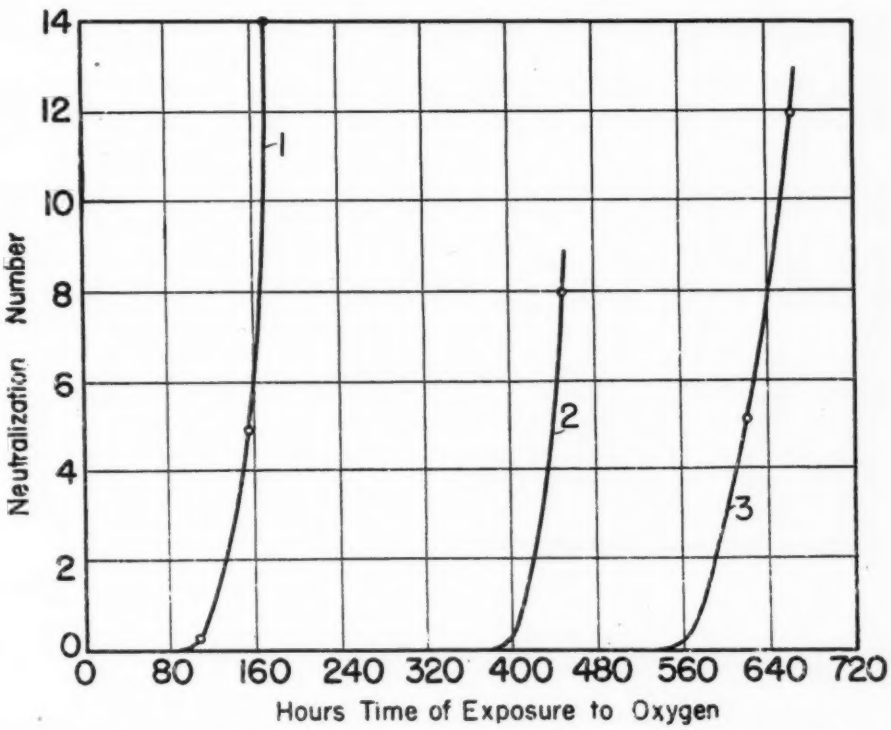

Fig. 2—Effect of addition of antioxidants to lubricating oils to improve anticorrosive properties. Curve 1, plain oil; curve 2, same oil with 0.01% alkyl phenol; curve 3, same oil with 0.01% alkyl phenol and 0.01% alkyl succinic acid. (U.S. 2,442,672)

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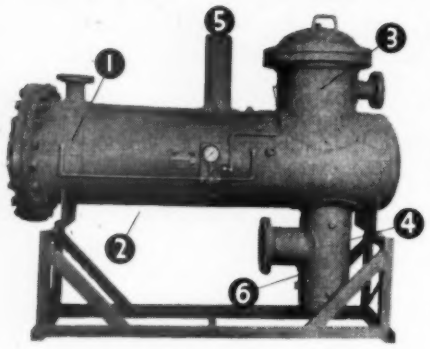

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Patent Trends

Production of thiophene derivatives by separately preheating sulfur and selected hydrocarbons having at least 4 carbon atoms in a straight chain and combining in a reaction temperature of 850 F.-1300 F. U.S. 2,450,685-6-7; Herbert E. Rasmussen and Rowland C. Hansford, to Socony-Vacuum Oil Co., Inc.

Method of refining lube oils which consists of treating the selected charge stock with an alkaline reagent before phenol extraction. U. S. 2,451,025; Harold L. Elder to Standard Oil Development Co.

Polymerization of ethylene with a catalyst consisting of silica gel, alumina and a nickel-cobalt metal. U. S. 2,452,190; Stanford J. Hetzel and Robert M. Kennedy to Sun Oil Co.

Process for treating hydrocarbons in presence of contact material, which includes passing hydrocarbons from reaction zone into a mixing zone where other hydrocarbon material is introduced and passing mixture into another contact zone. U. S. 2,452,569; Eugene J. Houdry to Houdry Process Corp.

Process for synthesizing gas from oil shale which comprises reacting oxygen and shale particles in upper part of reaction zone to produce CO and hydrogen; passing hot spent shale to lower part of reactor; introducing mixture of methane and water into spent shale to convert it to synthesis gas; withdrawing synthesis gas from intermediate zone. U. S. 2,452,634; Alfred Clark to Phillips Petroleum Co.

Improvement in process for synthesizing CO and hydrogen with accompanying formation of water, comprising introducing a dessicant to combine with water in the reaction zone to form compound of lower dissociation pressure than the pressure of the water. U. S. 2,452,712; Harold V. Atwell to The Texas Co.

Manufacture of sulfur dioxide-olefin resin in powder form, by reacting a mixture of propylene, butane-2 and butane-1 with liquid anyhdrous sulfur dioxide, agitating the resulting solution in water to precipitate the resin as slurry, settling and drying. U. S. 2,453,039; Allison K. Scribner and Frank W. Wilder to Phillips Petroleum Co.

Process for a lubricating grease containing aluminum soap. U.S. 2,449,580; Alan Beerbower and John C. Zimmer to Standard Oil Development Co.

Alkylation process which includes continuously recycling part of the isobutane in an isobutane-acid emulsion to maintain an isobutane-butene feed rate of 1 to 1500. U. S. 2,453,765; Donald G. Stevens to S. O. Ohio.

Producing butadiene by catalytic dehydrogenation of butylene, picking up the butylene vapors in superheated steam and passing the mixture to a dehydrogenating catalyst. U. S. 2,451,040; Eger V. Murphree to Standard Oil Development Co.

Synthesis of liquid hydrocarbons by forcing carbon monoxide and hydrogen through a fluidized synthesis catalyst and a dehydration catalyst in the same suspension. U. S. 2,453,874; Sumner B. Sweetser to Standard Oil Development Co.

Process for decolorizing deoiled, asphalt-wax tank bottoms by clay and solvent treating, to give a high melting point wax. U. S. 2,453,933; Paul L. Polizzotto and Peter Stanley Backlund to Union Oil Co. of California.

Isomerizing butane by passing a butane-hydrogen chloride mixture through solid aluminum chloride and contacting in a second reaction zone the effluent and a remaining portion of the charge stream with an aluminum chloride-hydrocarbon complex slurry. U. S. 2,454,149; Leslie U. Franklin and Charles F. Plumhoff to Gulf Oil Corp.

Producing a paraffin hydrocarbon from an olefin hydrocarbon by separation of desired polymers by distillation, isomerizing with brucite catalyst and catalytically hydrogenating the isomerized polymer. U. S. 2,454,171; Harold J. Hepp to Phillips Petroleum Co.

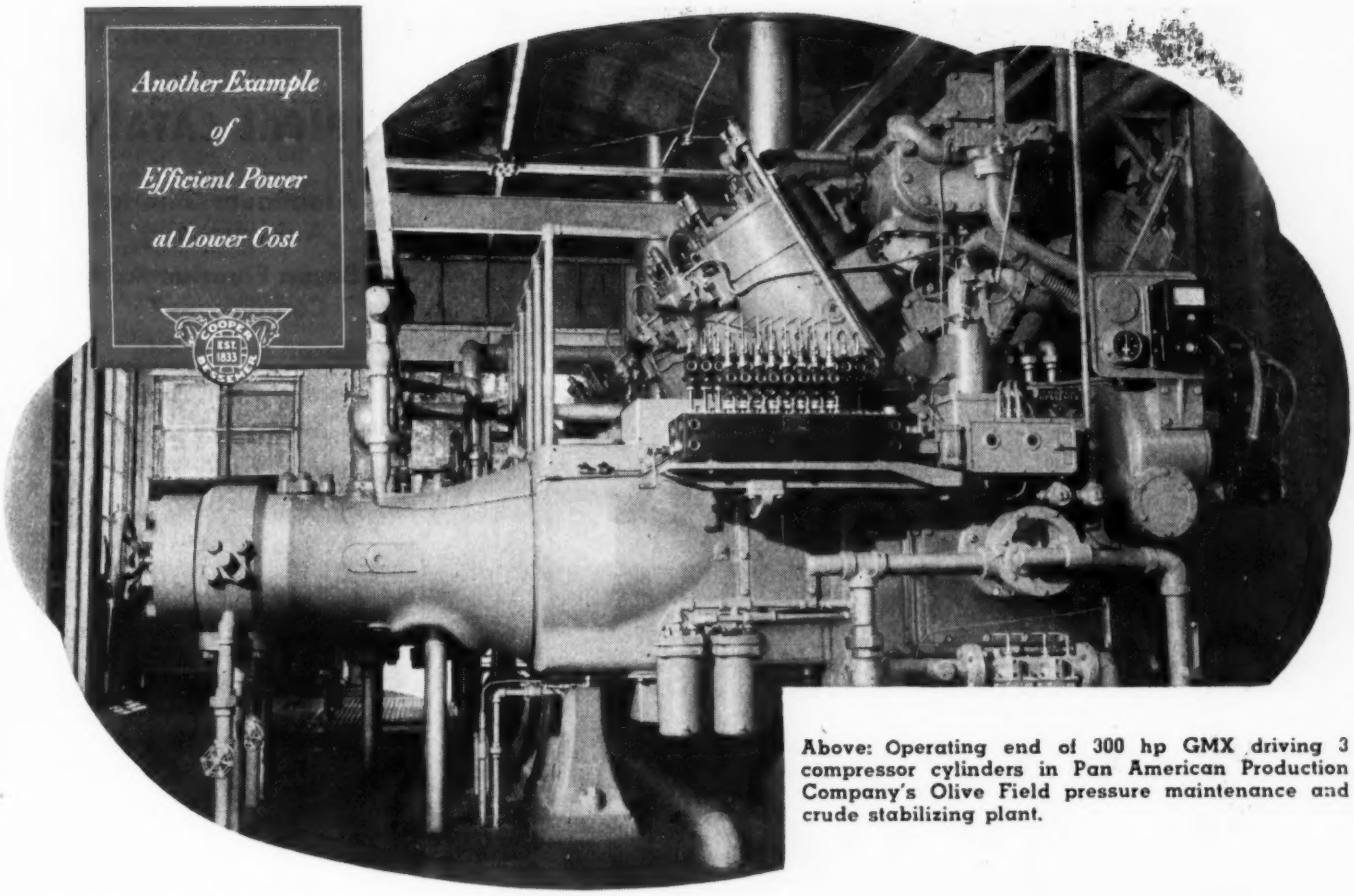
Overhead cooling of fluidized catalyst regenerator, by introducing into upper zone of regenerator a second stream of unregenerated catalytic material, the burning of the combustible deposits from which reduces the free oxygen present in the zone and prevents the secondary combustion of carbon monoxide. U. S. 2,454,373; Forrest H. Blanding to Standard Oil Development Co.

In treating distillates to remove mercaptans where foaming occurs, treating first with barium hydroxide and caustic of 5-15°Be. to remove hydrogen sulfide and troublesome carboxylic acids, then with caustic of 15-35°Be. to remove mercaptans. U. S. 2,454,383; Jacon Benjamin Heid to Universal Oil Products Co.

Dehydration of methyl ethyl ketone by azeotropic distillation under superatmospheric pressure. U. S. 2,454,447; William S. Harney, Jr., and Erwin H. Amick, Jr., to Standard Oil Development Co.

Process for purifying aromatic hydrocarbons by passing through successive catalytic environments, including dehydrogenating and cracking. U. S. 2,455,634; Philip J. Wilson, Joseph H. Wells and Charles R. Liebel to Carnegie-Illinois Steel Corp.

Another Example of Efficient Power at Lower Cost



Above: Operating end of 300 hp GMX driving 3 compressor cylinders in Pan American Production Company's Olive Field pressure maintenance and crude stabilizing plant.

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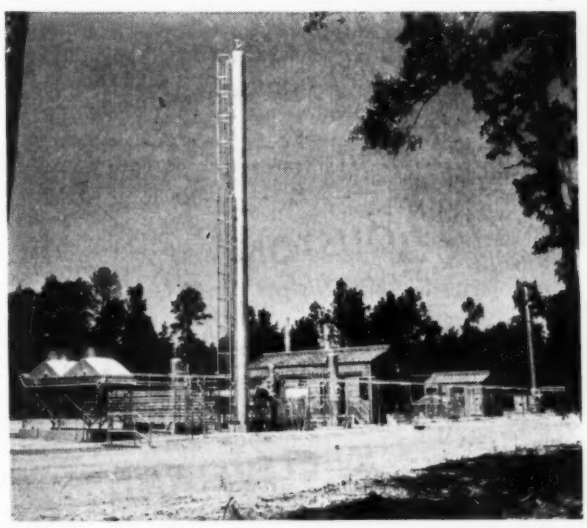

General view of plant. All gas, formerly wasted, is now returned to producing reservoir or used as plant fuel.

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Patent Trends

Separation by radiant energy of a continuous fluid system comprising principally components of the same phase temperature but having different capacities to absorb radiant energy, by adjusting the temperature of the system to a point of incipient phase change while subjecting it to radiation, thereby inducing phase change of one component and suppressing that of another. U. S. 2,455,812; Carleton H. Schlesman to Socony-Vacuum Oil Co., Inc.

Cooling of flue gases in fluidized catalyst regeneration by injecting water into regeneration gas outside regeneration zone, to control afterburning of regeneration gas. U. S. 2,454,466; Earl J. Le Roi to Standard Oil Development Co.

Process for removing minor portion of olefins from aromatic hydrocarbon feed stock by vaporizing and treating with aryl sulfonic acid and concentrated sulfuric acid, separating the aromatic hydrocarbons from the liquid phase. U. S. 2,454,467; Robert M. Love to Standard Oil Development Co.

Improvement in alkylation of isobutane with ethylene, including continuous introduction of small amount of BF_3 with the hydrocarbon feed into the reaction chamber. U. S. 2,452,166; Herbert E. Vermillion to The Texas Co.

Catalytic cracking of hydrocarbon oils heavier than gasoline with hydrofluoric acid in amount at least equal to weight of the oil, removing dissolved catalyst from reaction product by distillation, recovering hydrocarbons of gasoline boiling range. U. S. 2,454,615; John A. Ridgway Jr., and Philip Hill to Pan American Refining Corp.

Producing aviation gasoline of increased aromaticity and isoparaffinicity by cracking gas oil with a synthetic alumina-silica gel catalyst, reforming the fraction boiling in the gasoline range at high temperatures and in presence of a dehydrogenation catalyst. U. S. 2,451,041; Eger V. Murphree to Standard Oil Development Co.

Control of temperature in regeneration of solid catalyst by passing through the bed a hydrocarbon stream to deposit uniformly at least 0.02 lb. carbon per pound of catalyst, then purging, then regenerating with oxygen and inert diluent. U. S. 2,454,901; Roy E. Vinyard and Wendell W. Roach to Phillips Petroleum Co.

Steps in producing a solvent of high solvent power and low odor, consisting of a highly branched paraffinic HF alkylate in admixture with an alkylated benzene. U. S. 2,455,601; Lloyd C. Morris to Phillips Petroleum Co.

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Gas Samples Taken Accurately And Proportional to Flow-rate

In addition to the gas sampling instrument described below, this month's review of new and improved devices used in petroleum processing and handling operations on which patents have been issued recently includes:

- **Molten lead lifts catalyst in moving-bed cracking unit**
- **Engine performance tested on simple miles/gallon meter**
- **Flow proportional to pressure drop across needle valve**

ACCURATE GAS sampling during chemical processing, particularly in petroleum refinery pilot plant work, is made possible by means of a pneumatically-controlled instrument which will accumulate a composite sample from a typical stream of varying composition and in direct proportion to the usually varying rate of flow. In addition, its pneumatic operation will reduce or substantially eliminate danger from fire or explosion it is said. The device is shown in Fig. 1.

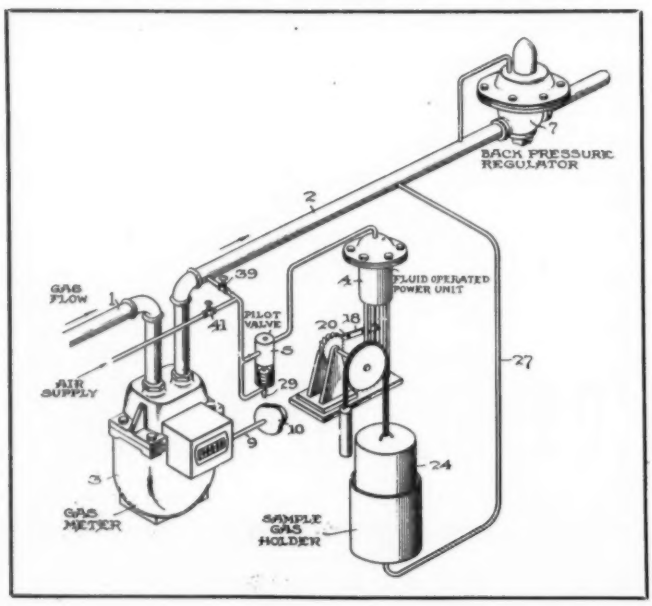
In operation; the sample holder bell 24 is first lowered completely within its shell. The gas stream, flowing from main 1 to main 2, will affect the operation of meter 3 in accordance with the flow rate, and will in turn cause cam 10 on integration shaft 9 to rotate in direct proportion to the gas flow. Once during each revolution cam 10 will restrict the discharge of air from nozzle 29 of pilot valve 5. This in turn will cause motion in lever 18 and pawl 20 through fluid-operated power unit 4, which finally causes an incremental raising of bell 24, thus drawing gas from main 2 through the sample line 27.

Back pressure regulator 7 maintains substantially constant pressure at the sampling point and assures obtaining equal increments of gas with each rise of bell 24.

Instead of using external air for operation, it may be desired to use the gas being sampled. This can be done by closing valve 41 and opening valve 39. Although designed primarily for obtaining a sample under low pressure, the instrument can be readily employed with gas under relatively greater pressure by installing a pressure reducing valve in line 27, or by designing the gas holder with a bell of proper strength and weight.

U. S. 2,452,143, issued Oct. 26, 1948, to Joseph A. Pelleterre, assignor to Gulf Oil Corp.

Fig. 1—Below; gas flow through meter 3 controls action of gasholder bell 24 for accurate sampling (U. S. 2,452,143)

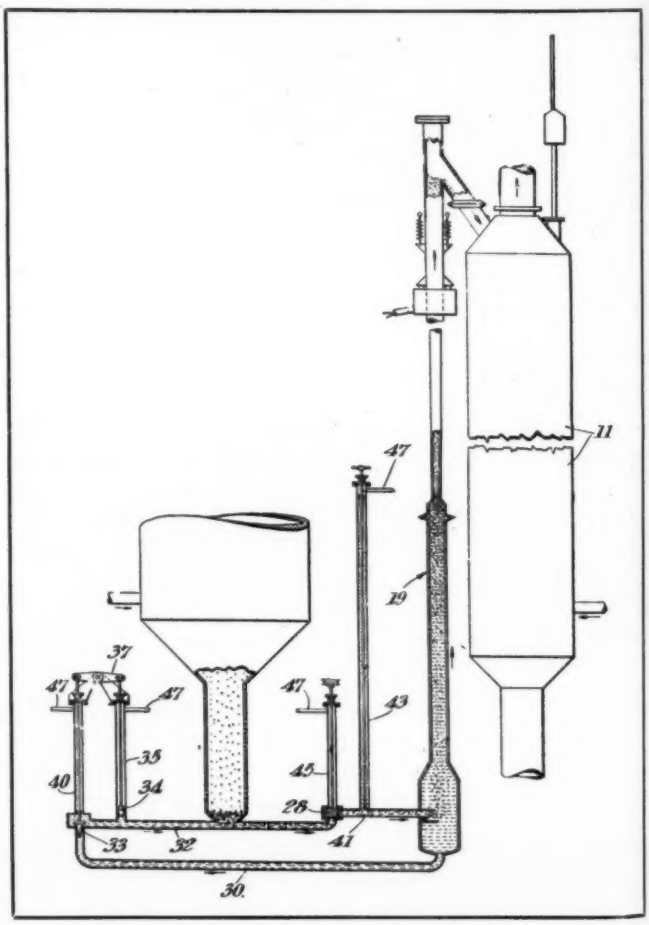


Molten Lead Is Catalyst lift In Moving-bed Cracking Unit

CATALYST TRANSFER on moving bed type catalytic cracking units can be effected by the use of molten lead, or liquid mercury, as a means of replacing the mechanical elevator and still provide a gas-tight liquid seal to prevent the exchange of gas between the reactor and regenerator zones. The sketch in Fig. 2 shows the arrangement for transfer of spent catalyst from reactor to kiln. A similar system is employed for transporting regenerated catalyst from the kiln back to the reactor.

The sealing and transferring liquid is preferably molten lead because 1) its specific gravity is such that great heights of liquid are not required to withstand operating pressures below 100 psig. 2) it does not wet the cata-

Fig. 2—Right; conventional mechanical elevator is replaced by molten lead as a catalyst lift (U. S. 2,453,458)



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lyst nor react with it, and 3) it will not materially vaporize at temperatures in the range of 800 to 1000° F.

In operation, the liquid is circulated by rotary impeller pump 28. It picks up catalyst at the lower end of the reactor, carries it on through to vertical lift pipe 19, is then separated from the catalyst, and returns to the starting point via line 30, flow control valve 33, and line 32. The catalyst, by virtue of its lesser density, floats up line 19 to the surface of the column of liquid lead and there, by accumulation, forms a column of catalyst moving up to be carried by conventional lines to the regenerator 11.

The height of the column of liquid metal in line 19 is controlled by valve 41. The rate of flow of the sealing liquid and the catalyst is regulated by needle valve 33, which is operated automatically by float 34 and the connecting lever arm 37. To prevent oxidation of the molten lead sealing liquid, air is excluded from all the vertical tubes, 40, 45, 43, and 35, by admitting steam through pipes 47.

U. S. 2,453,458, issued Nov. 9, 1948, to Carl S. Reed, A. H. Schutte, and Vernon O. Bowles, Lummus Co.

Engine Performance Is Tested On Simple Miles/gal. Meter

AUTOMOTIVE ENGINE performance can be determined in an improved miles/gallon meter which is said to eliminate the problems of cost and complexity usually encountered in conventional instruments because fuel consumption is obtained mechanically by a float mechanism and speed by the car generator in terms of voltage.

The new device employs a pair of individual cams, each actuated by a thermostatic element, one being controlled by a fuel flow meter and the other by a speedometer or tachometer. In the preferred form, the apparatus utilizes a separate car speed generator rotated by the fan belt to create current variations through one of the thermostats in direct proportion to the car speed. The fuel flow meter may be any suitable displacement type which can be used to vary the current in the other thermostat in accordance with the flow rate in the engine fuel line.

The relative motion of the two cams is in turn affected by the relative current variations in the thermostats. A pointer, connected to the proper location on the periphery of both cams gives a compositely integrated result on a dial. The dial can then be calibrated in any selected terms that will indicate the car speed divided by the fuel flow rate.

U. S. 2,454,393, issued November 23, 1948, to Charles A. Leonard, Cincinnati, Ohio.

Flow Is Proportional to Drop In Pressure on Needle Valve

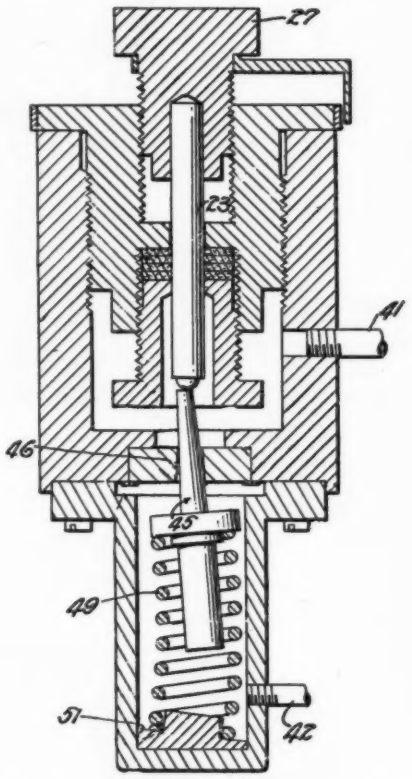


Fig. 3—Flow rate across orifice 46 is directly proportional to pressure drop in improved needle valve (U. S. 2,452,956)

NEEDLE-TYPE PLUG valves for controlling microscopic fluid flows can be designed so the flow rate is substantially in direct proportion to the pressure drop across the valve orifice. It has been found that this can be accomplished by an arrangement whereby the flow passage varies from a crescent shape at each end of the orifice to an annular shape at the mid-portion. A valve of this design is illustrated in vertical cross section in Fig. 3.

Pipe connections are indicated at 41 and 42. Up-and-down, or closing and opening, movement of the tapered plug 45 in tapered orifice 46 is provided by stem 23, which is forced down by rotating the control knob 27, and forced up by compression spring 49. The inclined position of plug 45 is maintained because spring 49 has its lower end resting upon a tilted surface 51.

This arrangement causes plug 45 to remain tilted throughout all positions except when fully closed. At all other times, its position in the tapered orifice effects the desired configurations in the fluid passage; i.e., crescent-shaped cross sections at upper and lower ends and substantially annular cross section at the mid-point of the orifice.

U. S. 2,452,956, issued Nov. 2, 1948, to John W. Robins, assignor to Mason-Neilan Regulator Co.

How to Obtain Patents

Readers may obtain copies of any U. S. patents from the Patent Office at 25 cents each. Order by patent number direct from: The Commissioner of Patents, Washington 25, D. C.

Other Recent Patents

Space does not permit the complete review of all patents issued recently on equipment for the petroleum processing industry. Following, however, are brief abstracts of those with the greatest interest:

Fluid Catalytic Cracking Unit in which undesirable "afterburning" in lines beyond the first cyclone separator is overcome by the injection of liquid water into the dilute catalyst phase at such locations. U. S. 2,454,466, issued November 23, 1948, to E. J. Le Roi, assignor to Standard Oil Development Co., Baton Rouge, La.

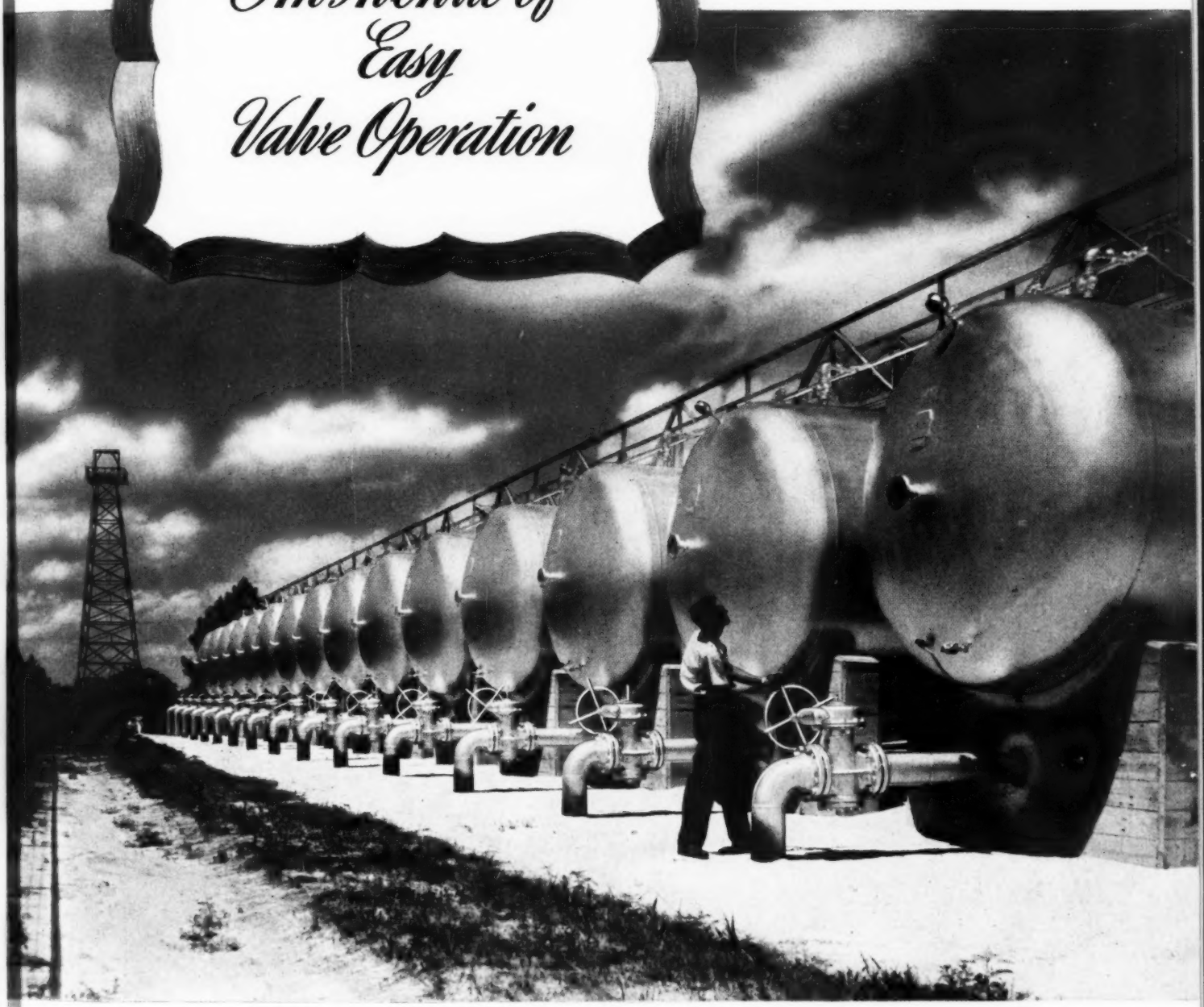
Gas Compressor of low first cost and increased flexibility uses interchangeable, standard cylinders, pistons, etc., to produce a two, four, or six cylinder machine with delivery rates corresponding to the number of cylinders. U. S. 2,454,600, issued November 23, 1948, to Wm. V. Fischer, assignor to The Air-Flo Compressor Co., Akron, Ohio.

Floating Roof Tank Piping using pantograph type arrangement in guiding grooves so as to prevent thrust and rotational stresses on shell and roof. U. S. 2,450,758, issued Oct. 5, 1948, to Wilbur G. Laird, Pleasantville, N. Y.

Vacuum Still for reclaiming laboratory mercury operates automatically by means of the barometric leg principle, and incorporates an automatic current shut-off when mercury runs low in the charge reservoir. U. S. 2,450,098, issued Sept. 28, 1948, to Marvin A. Smith, assignor to Universal Oil Products Co., Chicago.

Tube Gage for checking internal diameters of refinery tubing and pipe, in which the gage pin ends are provided with rollers to reduce the inaccuracies usually encountered because of wear. U. S. 2,451,600, issued Oct. 19, 1948, to C. H. Woodcock, assignor to Atlantic Refining Co., Philadelphia.

An Avenue of Easy Valve Operation



YOUR tanks may not be butane tanks like those in the picture, but they need safe, easily-operated valves just as much, no matter what they hold. Exposed to the elements, Nordstrom valves are weatherproof. Their simple quarter-turn is time-saving, especially where there's a long row to operate. But more important, Nordstroms will not stick or gall, leak or corrode. The tapered rotary plug, seated on a film of lubricant, turns easily. A thin coating of lubricant, injected under pressure higher than that of the line, seals each port against leakage. Nordstroms are the *best* valve equipment for your lines.

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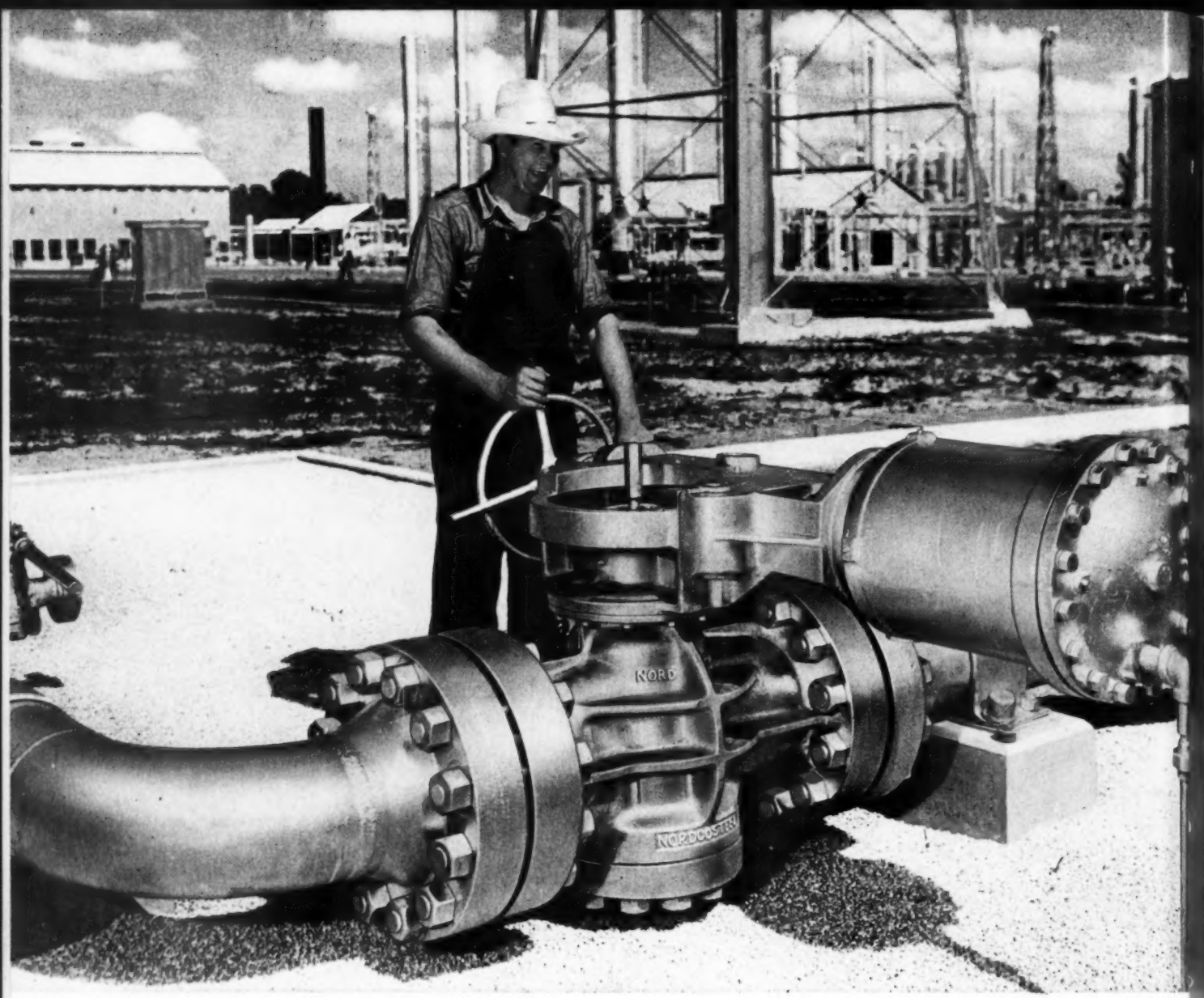
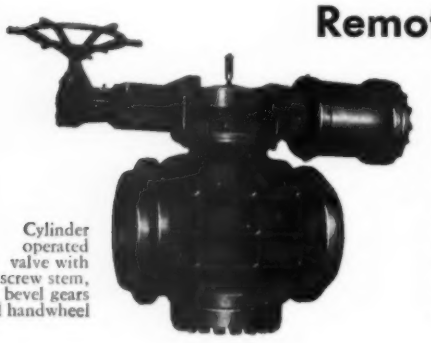


Hypreseal cylinder operated valve installation, showing manual operation with handwheel.

Remote Control or Hand Operation



Cylinder operated valve with screw stem, bevel gears and handwheel

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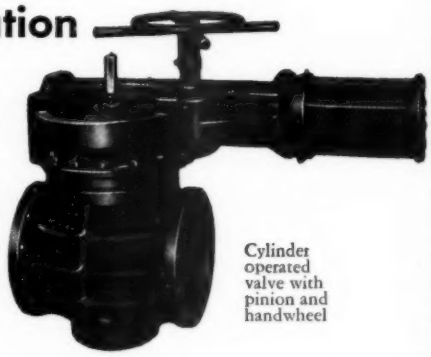

Cylinder operated valve with pinion and handwheel

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'Gadgeteering' the Valve Positioner

Unorthodox Hook-ups and Adaptations of the Conventional Valve Stem Position Controller Increase its Usefulness in Processing Plants

By RALPH D. WEBB
Instrument Division, Carbide and Carbon Chemicals Corp.

WE commonly refer to an unusual or unorthodox hook-up of industrial control instruments as "gadgeteering", especially if the hook-up is tricky. No man in this field of work can resist the temptation to indulge in gadgeteering—nor can he well afford to refrain from it.

The instrument or device we have found most susceptible to use in unorthodox ways is the valve stem position controller. I call it that rather than its conventional name—valve positioner—to emphasize the fact that it in itself is a controller, although it is referred to as a valve positioner. Now, remembering that it is a controller, let's look into the bag of tricks that we have developed for it.

I believe I'm safe in saying that the positioner we used was not intended by its designers to do any of the tricks to which it was adapted, nor do I want to give the impression that because I refer to but one make of positioner it is the best or only one for this kind of gadgeteering.

One of our early efforts along this line, back in 1935, was the use of positioners to operate multiple valves in sequence with a single controller. Fig. 1 shows our way of doing this. Here an intermediate or low pressure steam header is maintained at a quite constant pressure regardless of whether or not the steam consumed by the stills and that produced by the compressor exhaust is in balance. Note that the overall action of the valves as shown by the air pressure settings calls for the make-up valve to be air-to-open and the vent valve to be air-to-close. Perhaps the men who must operate this plant feel that both valves should close in the event of a general failure of the instrument air supply. This is achieved by using an air-to-open vent valve and then interchanging the bellows and its opposing spring in the positioner to give the action originally shown. The valve will still open with decreasing air pressure from the controller but naturally must close if the air supply to the positioner drops to zero. In 1935, this was unorthodox and could be done with but one make of valve positioner.

Often control valves riding close to their seats will tend to plug by having their port openings bridge over with suspended solids. We figured that, if we could pulse the valve at a relatively high frequency, we would prevent this tendency to bridge and plug. This was a "natural" for the gadgeteer. We altered the positioner to do just that. Fig. 2 shows schematically what we did.

As stated earlier, the positioner is a controller. Formally it is a narrow band proportional controller. The addition of the bellows below the nozzle speeds the usually smooth and accurate positioning of the valve stem, for each time the flapper approached the nozzle this little bellows huffed up and pushed the nozzle hard against the flapper, causing, through the usual chain, the valve stem to hurriedly push down. This caused the flapper to withdraw, but just as soon as the space between the flapper and nozzle became a few thousandths of an inch, this same bellows violently pulled the nozzle away from the flapper, thus reversing the movement of the valve stem. A pulsing or pumping cycle was set up, all without any change in pressure of the air from the main control instrument.

The amplitude of the cycle is adjustable by varying the stroke of the little bellows and by linkage changes; the period, by means of a variable resistance or restriction in the air line to the valve diaphragm.

A need occasionally felt in plants such as my own is that of a transmitter of mechanical position. Say we want independently to transmit the stem position of a very important motor valve back to the control room. All that is necessary is to take our old friend here and do as shown in Fig. 3—tie the relay output back to the main bellows. This is a quite handy gadget to have available.

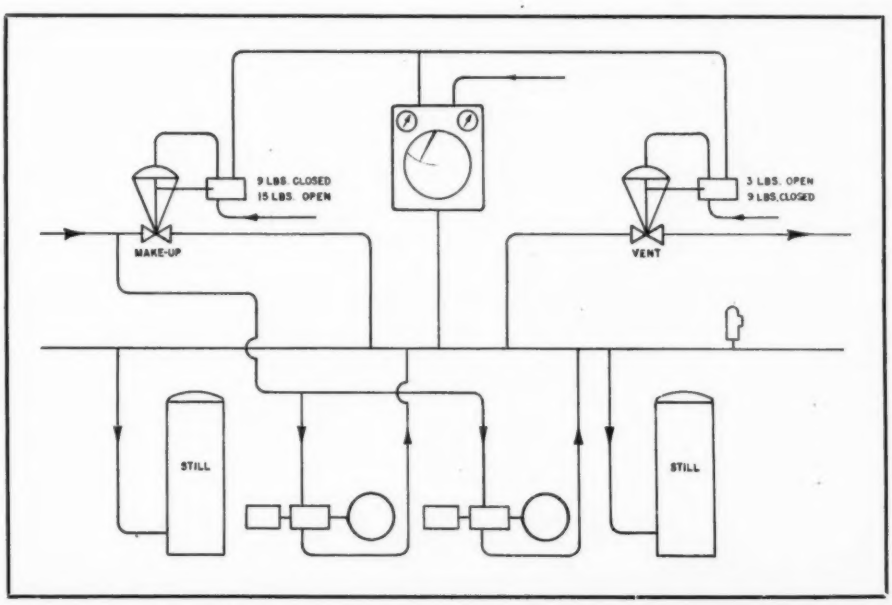


Fig. 1—Use of positioners to operate multiple valves in sequence with a single controller

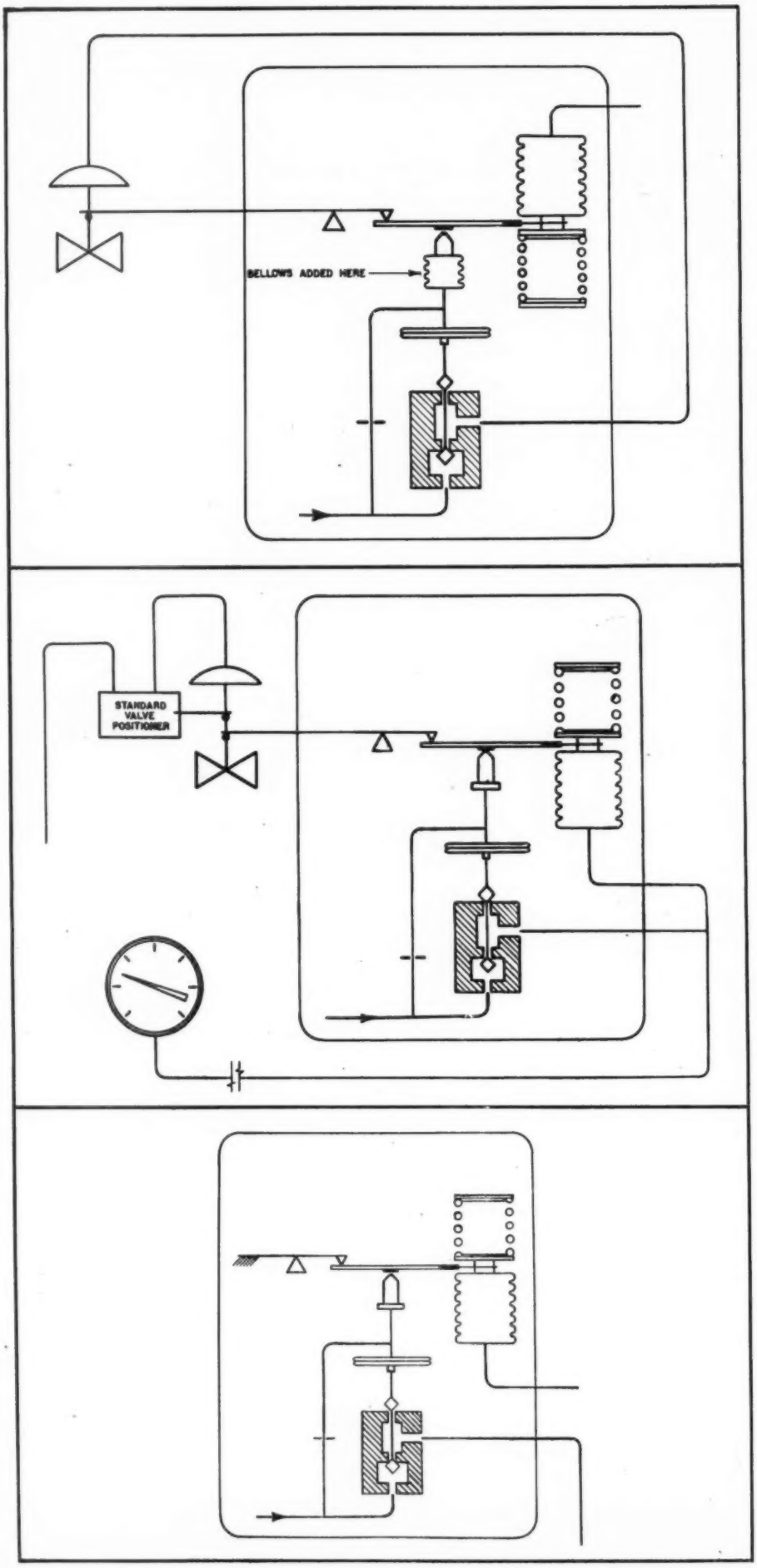


Fig. 2 (Left, Top)—Altering positioner to pulse the valve at a relatively high frequency, to prevent port openings bridging over

Fig. 3 (Left, Center)—Using the positioner to transmit mechanical position to the control room

Fig. 4 (Left, Bottom)—Setting the device to give a full change in output pressure at any desired pressure on the main bellows

We use it on ball floats to transmit position; on variable orifices, to transmit and also to record the orifice settings. We have even gone so far as to transmit the position of the scale levers in weigh tanks.

The natural next step is to use this as part of an interlock between valves with all the reliability and safety of air-actuated instruments.

Taking this same hook-up but with the pivot of the mechanical feedback lever held rigidly, as Fig. 4 shows, and with bellows pressure coming from some other controller, we can set this device to give a full change in output pressure—and either direction—at any desired pressure on the main bellows. With this, snap action can be achieved at any point in the 3-15 pound control band. This is a very popular gadget up our way.

Early in the war we got into a minor jam in one of our steam generating stations. A large expansion valve needed to be changed over from reducing to back pressure service. The hitch was that the valve required a very low range on its piloting mechanism—a matter of a few inches of mercury. The only spare controllers we had were of the standard output range, which was approximately four times that of the valve pilot. We took one of our old faithfuls and operated on it a bit. Fig. 5 shows the result. The bellows were 2-in. and 1-in. diameters respectively, giving us a 4 to 1 reduction in pressure. This worked quite well and, so far as I know, is still in service.

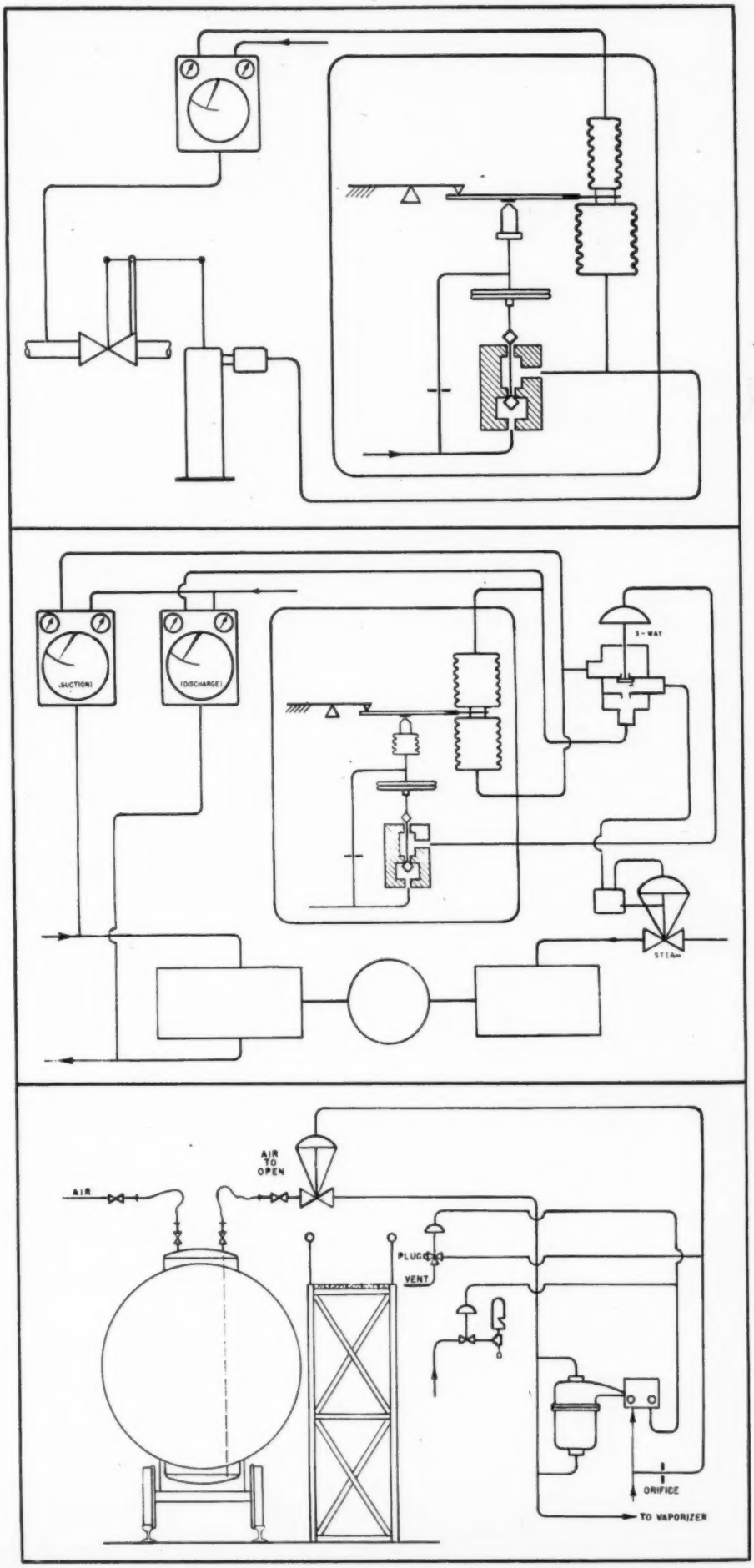
A need now met with a standard instrument but which, to our knowledge, was not a few years back was that of a selector relay which would preferentially cut in whichever of two controllers tended to close, or to open a given motor valve. A common case is that of a gas compressor with a controller on its discharge pressure commanding a valve on steam to the power end. Should the suction pressure of the compressor drop too low, it is often desirable to slow the compressor regardless of the discharge pressure going low, but still the latter must take over automatically in case it goes above the set point. Our answer was again found in our old gadgeteers' friend.

This time we needed a little help

Fig. 5 (Right, Top)—Hook-up with a large expansion valve in back pressure service which required a low range on its piloting mechanism

Fig. 6 (Right, Center)—Use of valve positioner as selector relay

Fig. 7 (Right, Bottom)—Gadgeteering service for a standard buoyancy type of liquid level controller in unloading chlorine cars



from a small air-actuated, three-way valve, as we see on Fig. 6. Note that again we have the little bellows under the nozzle to assure snap action so the three-way will not float between the two controller outputs. By careful adjustment we were able to make the motor valve swing to the non-controlling instrument output when the latter dropped but two or three inches of water below the other.

I suspect that none of the other standard instruments lend themselves to gadgeteering as well as does the valve positioner, but just to show you that there are others let me describe what we did on a chlorine unloading job. Here, in Fig. 7 we have used a standard buoyancy type of liquid level controller. When the operator has pressure up on the car and his valves all lined up, he places his finger over the little vent pipe on the three-way valve thus causing air pressure to build on the motor valve.

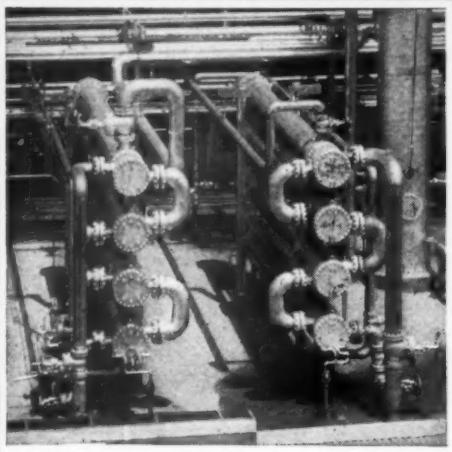
The liquid chlorine then fills the line to the vaporizer, causing the level controller to fill, thereby building air pressure on the three-way and on the whistle valve. This takes but a few seconds—not too long a time for the operator's finger. When the car is empty, air enters the unloading line and causes the level controller to actuate the two small diaphragm valves. The main motor valve is closed and the whistle sounds. The operator has to climb up a rack to shut off the whistle by means of the little automatic reset valve shown below the whistle.

This application of standard items in such an unorthodox manner really works. It gets all of the chlorine out of the cars and has often saved the plant chlorine system from undesirable and perhaps dangerous shots of air.

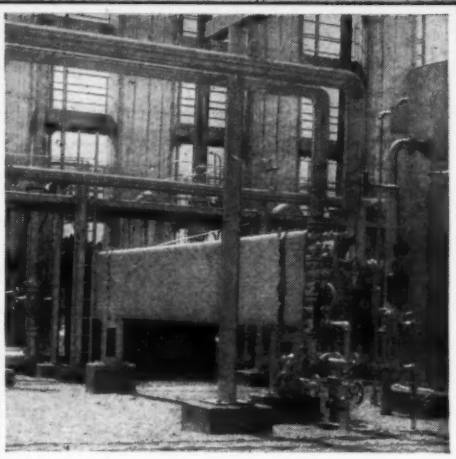
It is natural for the instrument mechanic and his boss to work to install instruments using trick hookups. This is good and will be profitable if kept under control.

Acknowledgment

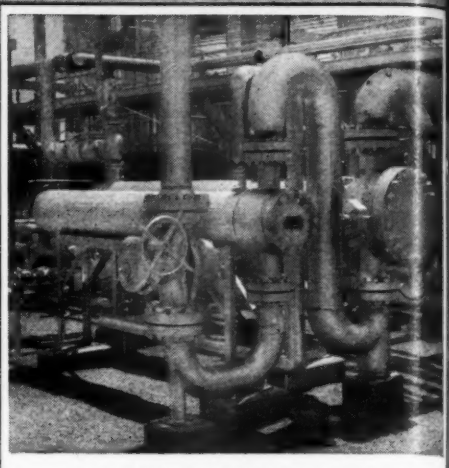
This paper, under the title "New Adaptation of Old Instruments", was presented before the Short Course on Instrumentation for the Process Industries, Oct. 26-28, 1948, Texas A. & M. College, College Station, Texas.



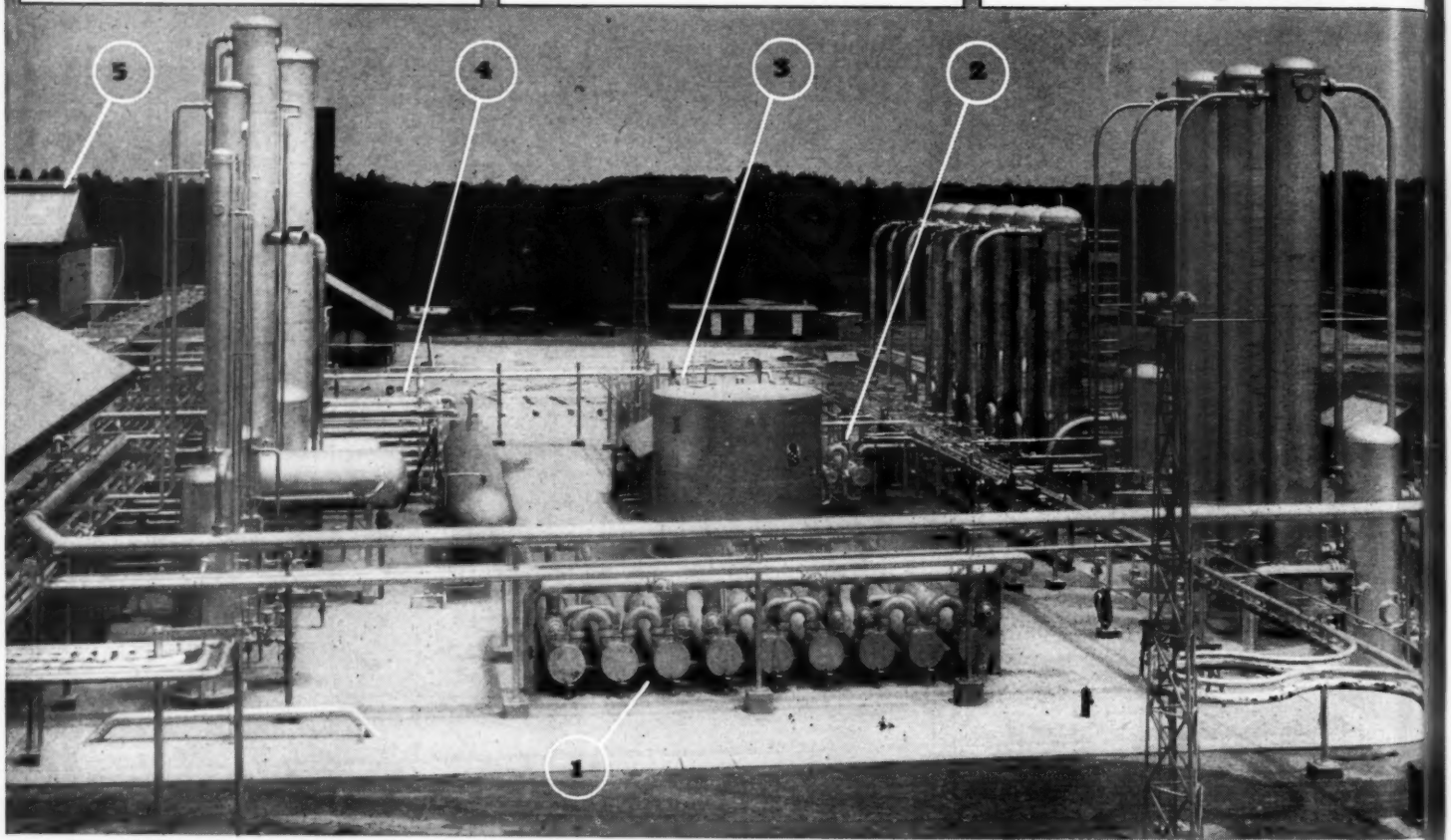
4. G-R Tubular Still Feed Exchangers and Preheaters



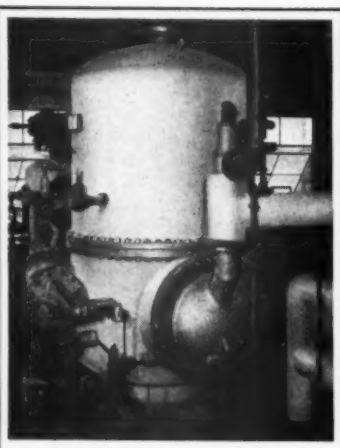
3. G-R Twin Bare Pipe Section Boiler Feedwater Exchangers



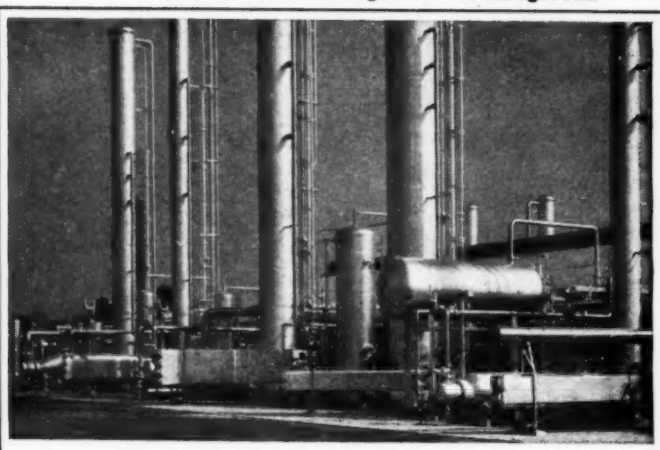
2. G-R Tubular High-Pressure Gas Heaters for regeneration of dehydrating material



1. General view of portion of the Feasel and Kinsey Plant of Chicago Corp., at Carthage, Texas, showing a row of nine G-R Tubular Units used as main exchangers in the foreground



5. G-R Bentube Evaporator for distilling the feedwater make-up for the high-pressure boiler plant



G-R Kettle Type Reboilers and G-R Twin G-Fin Section Fractionator Column Feed to Product Exchangers

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Bentube Evaporator

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NEWS OF

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Expansion, Transition

Emil Greiner Co., manufacturers and distributors of research and industrial equipment and chemical supplies, has moved to a new nine-story building at 20-26 N. Moore St., New York 13, N. Y. Top floor of new building contains a complete machine shop. Glass blowing activities are centered on the eighth floor, and engraving volumetric, hydrometer, and thermometer work is done on the seventh floor. Stock warehousing is on floors three through six; office on the second, and shipping, receiving, and counter sales on the first floor.

V. E. Middlebrook, formerly manager of gas-gasoline operation in the mid-continent area for Shell Oil Co., has resigned to become an active private engineering consultant, with offices in the Citizens' National Bank Bldg., Tulsa, Okla. A graduate of Texas A & M College in 1928, Mr. Middlebrook has been associated with Coltexo Corp., Phillips Petroleum Co., Texas Empire Pipe Line Co., and for the past 12 years with Shell Oil.

Farris Engineering Corp., makers of safety, relief and pinch valves, held a two-day technical conference in Cleveland recently for some 25 agents in the Buffalo-Cleveland-Pittsburgh area.

John Nooter Boiler Works Co., in concluding phase of its $500,000 expansion program, has purchased a number of major equipment items out of Mount Vernon, Ill., plant of J. P. Devine Division, H. K. Porter Co. Acquisition of this equipment and its removal to Nooter's St. Louis shops will help provide facilities for fabricating the larger tanks and heavier pressure vessels used in petroleum, chemical, and foods processing, according to Nooter vice-president Robert J. Ryan.

Personnel Changes

American Chain & Cable Co., Inc., Reading-Pratt & Cady Division—Charles L. Haslup has been appointed sales manager of field operations at Bridgeport, Conn.

Attapulgus Clay Co. — Irving A. Cole, formerly in technical sales, has been named Manager of the Technical Division and now is located at the company laboratories in Camden, N. J. Prior to joining Attapulgus in 1946, Mr. Cole was associated with the Research & Development Department of Atlantic Refining Co. at Port Arthur and at Philadelphia.

Babcock & Wilcox Tube Co.—William H. Buley, up from manager of general sales office to manager of stainless sales. James A. Anderson, up from assistant manager of New York District sales office to assistant general sales manager of company. Both men will make headquarters in Beaver Falls, Pa.

Bechtel Corp.—Fred W. Meyer has been named chief engineer of the Engineering Division. Mr. Meyer came to Bechtel in 1942 following seven years of design and process engineering with Standard Oil Co. of California, and has been active since in such projects as a 100-octane refinery at Richmond, a butadiene plant at El Segundo, and the Borger, Texas, toluene plant of Phillips Petroleum Co. In 1945, he visited Japan as head of the Oil Ministerial Group of the U. S. Strategic Bombing Survey. In his new post, he will have offices at Bechtel headquarters, 62 First St., San Francisco.

Blaw-Knox Co.—E. S. Wright has been promoted to manager of construction for the Chemical Plants Division. W. F. O'Neill succeeds Mr. Wright as general superintendent of construction. Prior to his connection with Blaw-Knox, Mr. Wright was engaged in general contracting in Philadelphia and for many years was employed in the oil refining and chemical processing industries.

Chiksan Co.—G. R. Winder returns to the parent company as vice-president and sales manager from a three-year tour of duty in the same capacity with Well Equipment Mfg. Corp., a Chiksan subsidiary in Houston. He will be at company offices in Brea, California.

Cooper Alloy Foundry Co.—All advertising, publicity, and public relations activities have been coordinated under the direction of George Black as the new Public Relations Division Manager. Mr. Black comes from the Nickel Sales Division of International Nickel Co., where his primary concern was publicity relating to nickel steels and irons.

Dearborn Chemical Co.—William J. Tobin as sales representative in Minnesota territory, headquartering in Minneapolis-St. Paul area, replacing the late A. A. Turner. Roy O. Benson as sales representative in Chicago area. E. W. Houseknecht, moved as sales representative in Chicago to Wisconsin, with headquarters in Appleton.

E. I. du Pont de Nemours & Co., Inc.—Dr. Emil D. Ries, in the Ammonia Department first in research and then in sales work since 1930, has been made general manager of that department. Charles T. Mentzer, Jr., formerly assistant manager of fine chemical sales in the Organic Chemicals Department, has been named sales supervisor in the department's New York office.

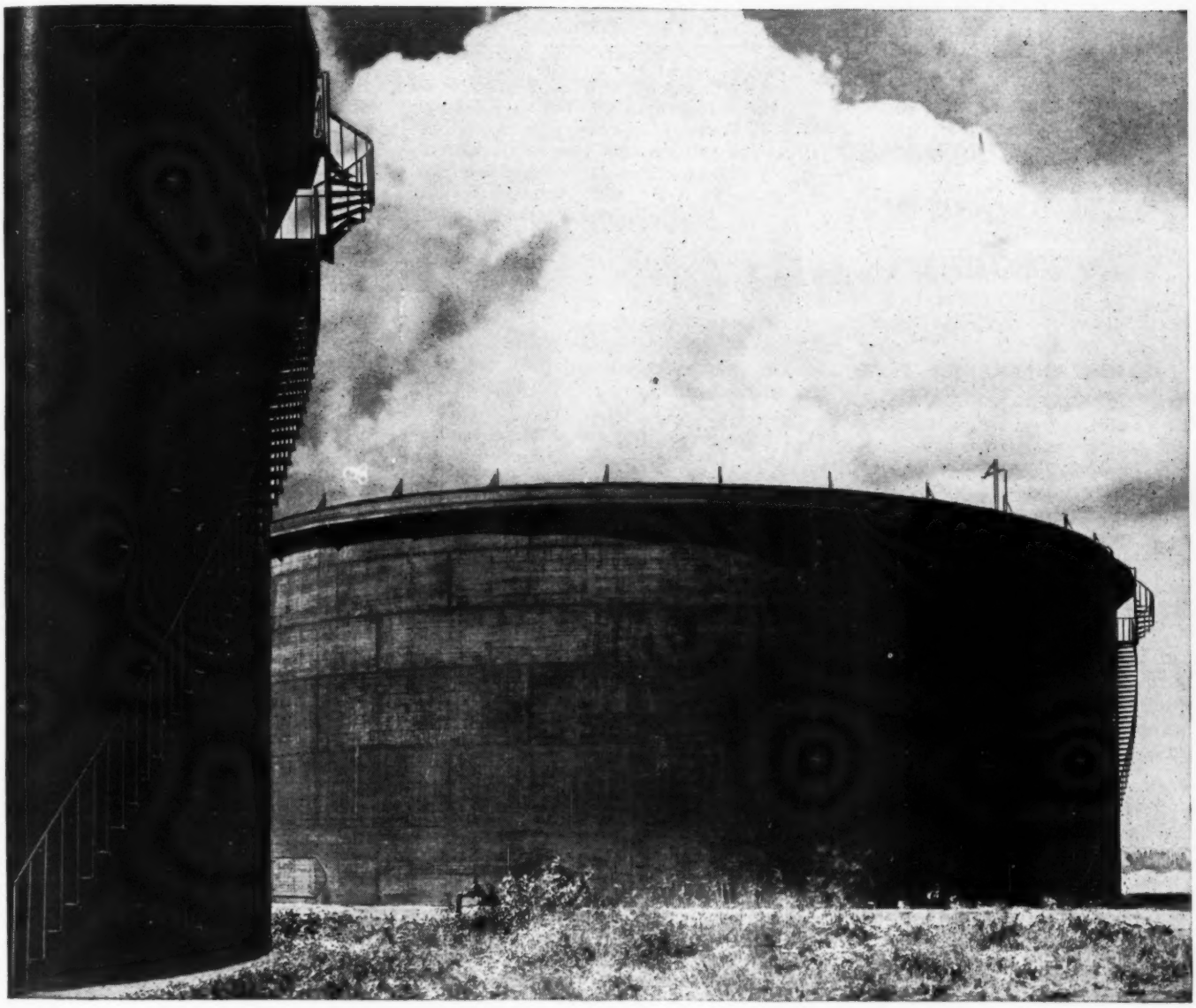
The Gas Machinery Co.—Arthur W. Krause and Alvin M. Cunningham have joined the engineering division. Mr. Krause previously served with American Gas Association Laboratories and in process development department of Shell Development Corp. Mr. Cunningham's previous experience also includes the AGA Laboratories as well as the Pennsylvania Railroad Co.

Jessop Steel International Corp.—Howard M. Dawson, formerly vice president and managing director, has been elected president. Company is a wholly-owned subsidiary of **Jessop Steel Co.**

Koppers Co., Inc.—McMillan Robinson has resigned as vice-president of the Ocean City Mfg. Co. to become sales manger of Koppers' **Metal Products Division,** recently formed to combine the company's Baltimore area manufacturing activities under one management.

National Supply Co.—George H. Shumaker, who started as a clerk in the company's store in Centralia, Ill., has been appointed Michigan District Manager, and will make his headquarters in Mt. Pleasant, Mich. **Superior Engine Division** of National Supply has named John J. Fetsko, Jr., as sales engineer in New Orleans, La.

National Radiator Co.—Walter D. Binger has been elected a director. Mr. Binger is vice-president of the City Investing Co., and president of City Construction Co., New York City.



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Patterson Foundry & Machine Co., Special Equipment Division—Joseph W. Kelley has been named division sales manager in charge of specially designed chemical and process apparatus. He will headquarter at main offices, East Liverpool, Ohio.

Pennsylvania Flexible Metallic Tubing Co.—Lionel Tinfow has been added to the staff of the New York branch office as a sales engineer, working under the supervision of Sidney V. Winton, New York Branch manager of Penflex.

Rockwell Mfg. Co., Pittsburgh Dubois Division—L. A. Dixon, Jr., has moved up from assistant general manager to general manager of that division.

Spencer Chemical Co. — Louis L. Ward, formerly with Sinclair Coal Co. of Kansas City, has joined the chemical sales staff of Spencer.

Taylor Forge & Pipe Works—Thomas J. Lingle has been put in charge of manufacturing operations at new Fontana, Calif., plant, and will also direct West Coast sales. Formerly associated with C. F. Braun Co., Mr. Lingle's new position is that of Western Division Manager.

Victor Chemical Works — William R. Dedert has been appointed to new post of general superintendent and will be in charge of manufacturing operations at Chicago Heights, Nashville, and new plant at Morrisville, Pa. Homer B. Terry, formerly superintendent at Nashville, succeeds Mr. Dedert as Chicago Heights superintendent. John A. Coben, previously general foreman at Nashville, becomes superintendent there.

Western Supply Co.—Willard A. Emery has been appointed new works manager at Tulsa plant, coming to Western after 25 years with Worthington Pump and Machinery Co. in various engineering and plant management positions at Holyoke and Harrison, N. J.

Wolverine Tube Division, Calumet & Hecla Consolidated Copper Co.—A. M. Younger has been appointed manager of southwestern sales, with offices in Houston. He replaces L. G. Fox, who developed company activities in the area and who has returned to home office in Detroit on special assignment.

New Developments

Use of a sensitive photoelectric cell to discover the presence of smoke is cited as a quick and reliable fire detection device, well in advance of other detecting devices in the case of smouldering fires, by Maynard A. Laswell, chairman of the Fact-Finding Committee of the Carbon Dioxide Fire Protection Industry.

When coupled with carbon dioxide extinguishing systems, the smoke detector apparatus acted in 38 seconds after a test fire was ignited in a fur storage vault at the Underwriters' Laboratories, according to Mr. Laswell. Although the test was in a fur storage vault, the system would serve to protect almost any stored and valuable materials in confined or semi-enclosed spaces, he added. It would be of equal service in industry, for example, for protecting important records, engineering drawings, patterns, and the like.

Branches, Distributors

National Supply Co. has organized a new division sales department with headquarters at Casper, Wyoming, to expand operations in northwestern United States and in western Canada. Staff members at Casper will include W. T. Cushing, Jr. as sales manager for the division, R. D. Stottlemeyer as division engineer, and K. L. Thompson. Mr. Cushing has been engineer in the Casper division since August, 1947. Mr. Stottlemeyer moves over from the plant products division at Houston, and Mr. Thompson from purchasing department in Toledo, Ohio.

Industrial Process Engineers, of West New York, N. J. have established a new sales office at 7309 East End Avenue, Chicago, Ill., centering in a new territory which includes Chicago, northern Illinois and northwestern Indiana. A. J. Foeley succeeds Raymond J. Selwyn as company's representative. A new sales office for the St. Louis territory has been established by James Dana at Suite 713, Ambassador Bldg., 411 North Seventh St., St. Louis 1, Mo. The Plant Equipment Co. will be new Cincinnati representatives, with offices at 946 Betts St., Cincinnati 14, Ohio. For the Pittsburgh and Cleveland districts, John B. Moorehead will be representative with headquarters at 336 Fifth Avenue, Pittsburgh 25, Pa.

Askania Regulator Co. has appointed Frank E. Early as its representative in Detroit. His address will be 15234 Michigan Avenue.

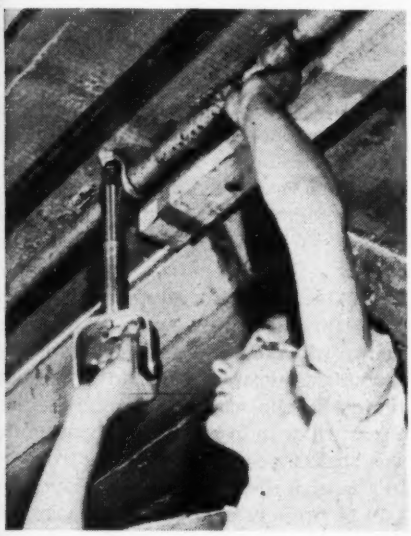
Monsanto Chemical Co. has created a new San Francisco office for its export sales department, to be located with the domestic sales organization at 111 Sutter St. Paul C. McMillan, formerly of the company's New York export sales offices, will be manager at San Francisco.

What's New!

EQUIPMENT . . . MATERIALS . . . PROCESSES . . . LITERATURE

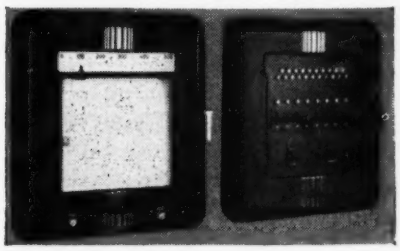
Reviewed by WILLIAM C. UHL, Equipment Editor

1—"Pistol" Tool Fastens Hangers



Tedious, time-consuming work with a star drill for fastening pipe hangers to concrete or metal can be eliminated with a newly-developed gunpowder-actuated driver which will "pin" a hanger to a concrete ceiling or wall, steel I-beam or column, in a few seconds. The portable, 5-lb. tool embeds studs in steel or masonry by the discharge of a blank cartridge. In operation, the stud with the cartridge attached is inserted in the barrel. The operator then rotates a spring-loaded safety arm 180 degrees to move the firing pin into position. The barrel is then held against the material to be penetrated, the tool is pushed forward sharply, and the cartridge explodes, forcing the stud outward. There is no recoil or flash; the tool can be operated with one hand. Hazards are minimized because firing pin cannot reach the cartridge primer until the safety arm is rotated. Accidental dropping of the tool also moves the firing pin out of position instantly. Two stud diameters—⅜ and ¼-in.—may be used through interchangeable barrels. Studs are available in externally or internally threaded, or plain headed types. Mine Safety Appliances Co.

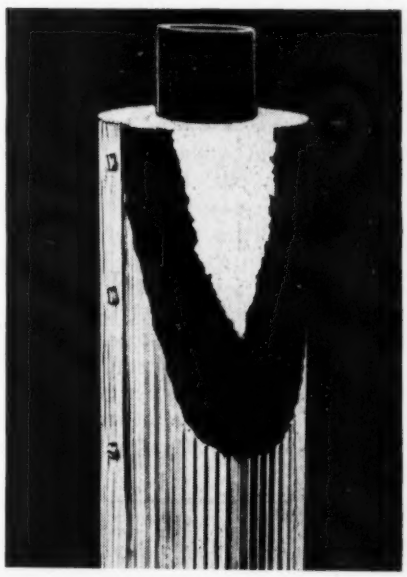
2—Multiple Temperature Recorder



Automatic logging of as many as 160 separate thermocouple temperatures in succession at a rate of 4 seconds per point is claimed as a feature of a new "Speedomax" temperature recorder. In case of trouble in a process, the operator can cut thermocouples out of the measuring sequence in banks of 20 each, until the instrument is concentrated on the group of temperatures he is interested in. Or, the instrument can be set to record any single point, or all points continuously. The equipment consists of two parts, a recorder and a switch assembly, both housed in separate cases. Leeds & Northrup Co.

3—Aluminum Pipe Jacket

Childers Aluminum Jacketing is a new light-weight sheet material, corrugated for strength and easy application. It comes with a moisture barrier attached and can be fastened at the joints with screws. Service life is estimated at 20 years and material can be re-used when lines are moved. It is manufactured from 0.0055-in. thick, No. 2-S aluminum with 3/16-in. corrugations. Moisture barrier has a base of 70 lb. kraft paper, impregnated with asphaltic compounds and coated with a seal mixture of gilsonite, resins, waxes, and special asphalts. The jacketing is shipped in rolls 4 ft. wide x 100 ft. long, each weighing approximately 63 lbs. The Childers Mfg. Co.



4—Alloy Welding Electrodes

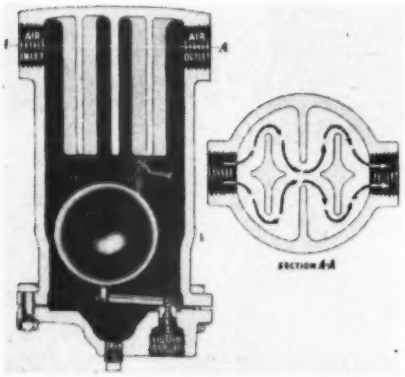
"Monend 806" welding electrodes are said to produce X-ray quality welds on monel, monel-clad, and steel, and will eliminate the need of depositing a buffer layer of nickel. Free-bend specimens exhibit elongation values of 50% or higher; typical weld metal yield strength is 42,500 psi, and tensile strength 75,500 psi. Arcos Corp.

More "What's New!" Items, p. 90

For More Information

Use one of the attached reply cards to request additional information or literature on any items reviewed in "What's New!" Just circle the numbers corresponding to the numbers on the items you're interested in, fill in the rest of the card, and drop it in the mail. No postage required.

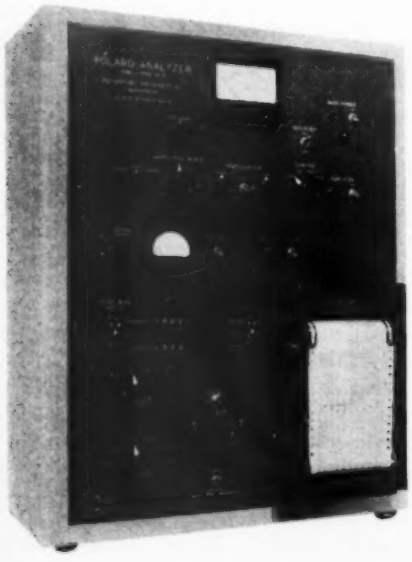
5—Combination Separator-Trap



The new design in the Clark Series 430 Combination Separator Trap is primarily for removal of entrained moisture and condensate from air supply lines, but it can be used effectively on steam and gas service. The unit utilizes a set of baffles to divert moisture to the collecting chamber where the conventional ball float trap discharges it to the drain. It is furnished in five sizes: ½, ¾, 1, 1¼ and 1½ in. Working pressures on the ½ and ¾-in. sizes range up to 150 psi., and on the other three up to 200 psi. Clark Mfg. Co.

6—Polarograph Makes Rapid Analyses

The "Polaro-Analyzer," now being made available for polarographic analysis, features the use of an undamped current recording system, in contrast to the highly damped galvanometers or recorders employed conventionally, according to the manufacturer. As a result, polarograms can be obtained over a complete 0-3 volt range in as little as five minutes without falsification of the half-wave potential. The instrument comprises a polarizing unit, a DC amplifier, and a recording milliammeter housed in a single cabinet. Six main polarizing ranges—0-1, 0-2, 0-3, 1-2, 1-3, and 2-3 volts—are available by use of a selector switch. An auxiliary switch makes available three other ranges in which the polarity of the dropping electrode is reversed during the run. Nine amplifier sensitivities—0.5, 1, 2, 5, 10, 20, 50, 100, and 200 microamps. full scale—are provided and selected by a single control. Rutherford Instrument Co.

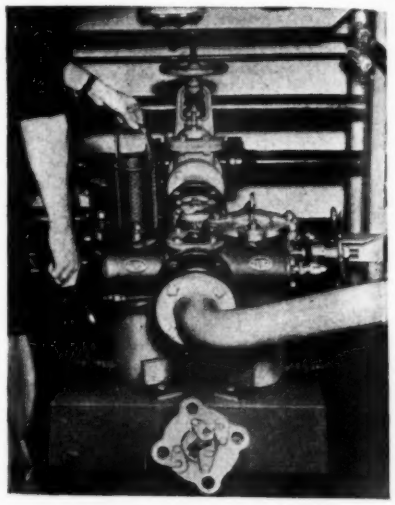


7—Civilian "Walkie-Talkie"

The first portable radio transmitter-receivers for public use are now in pilot plant construction, according to the manufacturer. The equipment is one-fourth the size of the wartime "walkie-talkie" and was made possible through the availability of subminiature electronic tubes made by Sylvania Electric Products, Inc. This Model 100-B "Transceiver," two of which are required for person-to-person air contact, is housed in a case measuring 6 x 2-7/8 x 1-1/4 in., and weighs 11 ozs., including antenna. Total station equipment carried by the user, including batteries, is 2-1/2 lbs. The unit is for Class B stations only, operates on the 465 megacycle band allocated by the Federel Communications Commission for civilian use. Citizens Radio Corp.

8—Strainer Handles Heavy Solids

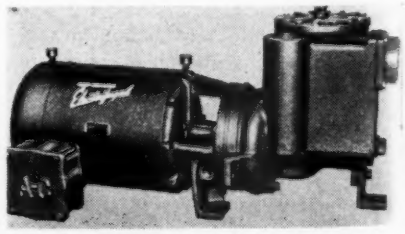
A double-basket-type strainer, designed to handle fluids with a high solids content without interrupting operations for cleaning, is suitable for both intermittent and continuous



flow and will handle sudden surges of solids. Flow is diverted from one strain chamber to another by a large, easily-operated handwheel. Removable covers facilitate lifting out the basket through which flow has been cut off. Valve seats are removable and valve stems are supported at both ends for accurate permanent alignment. A handhole above each valve assembly permits servicing without removing the strainer from the line. Pressure drop is minimized by setting the basket eccentrically with respect to the chamber, so that the flow section is proportional to the flow needs at all points. Units are available in bronze, steel, semi-steel, and cast-iron, with strainer baskets made to specifications in perforated brass, monel, or other metals, or in mesh or magnetic types. J. A. Zurn Mfg. Co.

9—Centrifugal for Light Oils

An addition to the "Electrifugal" line of close-coupled, electric motor-driven, self-priming centrifugal pumps has been designed for pumping gasoline, oil, kerosene, and other light distillants at bulk stations. It incorporates an automatic air evacuator during the priming cycle. Pumps are furnished in sizes from 1½ to 3 in., with capacities from 30 to 350 gpm. and heads up to 300 ft. Allis-Chalmers Mfg. Co.



More "What's New!" Items, p. 92

AUTOMATIC CONTROL EQUIPMENT

ENGINEERED DESIGN BY **HAMMEL-DAHL**

The "Dahl-Seal"®

Eliminates Packing Box Problems on High Pressure Control Valves

Patent Pending

ANOTHER Hammel-Dahl FIRST

Hammel-Dahl manufactures High Pressure Control Valves for operating pressures up to 15,000 PSI.

The Valve illustrated is the Hammel-Dahl ⅜" Type 7735ST High Pressure Valve with Dahl-Seal. Pressure tested at 22,500 PSI.

The "Dahl-Seal" provides a frictionless, leak-proof Valve stem, regardless of the static pressure in the system.

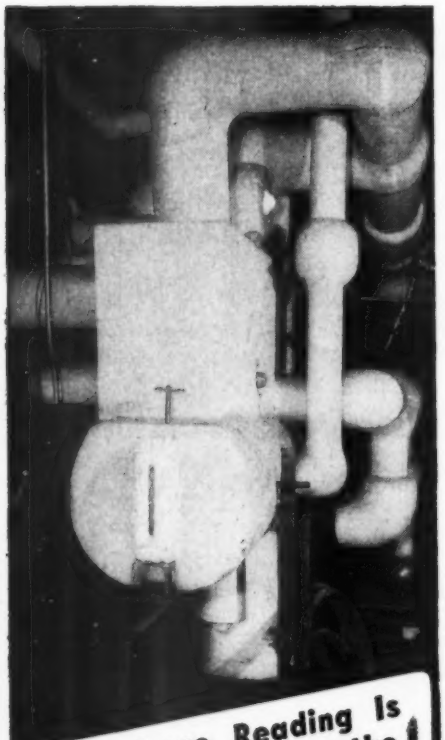
1. The valve stem can be positioned to an accuracy of 0.001" in high pressure valves at operating pressures up to 15,000 psi.
2. Eliminates conventional packing box leakage.
3. No periodic take-up or adjustment is necessary.
4. Seals by force of system pressure.
5. Negligible stem friction at any pressure
6. Completely resistant to chemical attack.
7. Can be used for any temperature for which the valve is designed.
8. Available for any Hammel-Dahl Valve, including those now in service.

HAMMEL-DAHL COMPANY

243 RICHMOND STREET, PROVIDENCE 3, R. I., U.S.A.

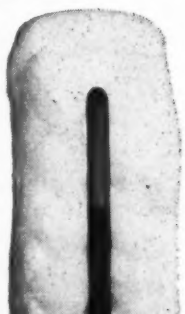
ALBANY BOSTON BUFFALO CHICAGO CINCINNATI CLEVELAND DALLAS
DENVER DETROIT HOUSTON KINGSPORT, TENN. LOS ANGELES NEW YORK
OAKLAND PITTSBURGH ST. LOUIS SEATTLE TULSA WILMINGTON, DEL.

In Canada, Railway & Power Engineering Corporation, Ltd.



The Gage Reading Is Always Visible on the NON-FROSTING JERGUSON GAGE

Special design of the Jerguson Non-Frosting Gage prevents frost from forming over the vision slot.



If you are gaging low temperature fluids . . . and have difficulty with frost on the vision slot . . . you need Jerguson Non-Frosting Gages.

With the Jerguson Non-Frosting Gage the liquid level reading is *always visible.*

A special frost preventing unit sealed to the gage glass projects beyond the cover bolts so the frost cannot build up across the vision slot in the cover forging.

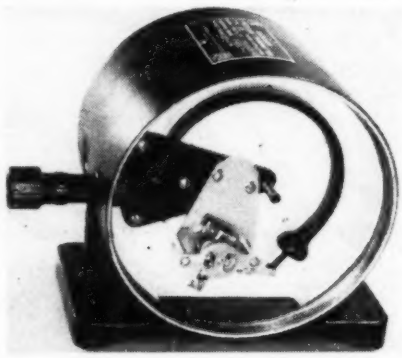
Don't guess any longer. Use Jerguson Non-Frosting Gages and *be sure* of your liquid level readings on low temperature work.

Write for prices and full details.

JERGUSON GAGE & VALVE COMPANY
100 Fellsway, Somerville 45, Mass.
Representatives in Major Cities
Phone Listed Under JERGUSON

What's New!

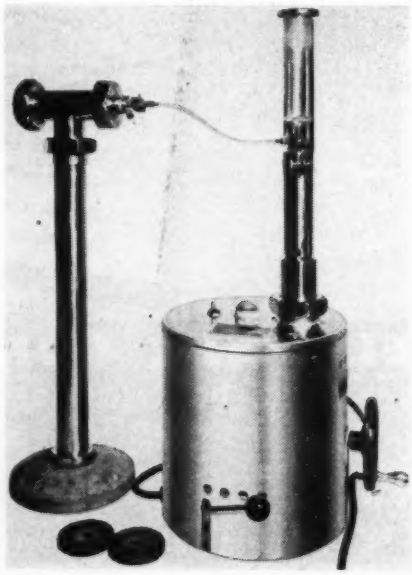
10—Pressure Transmitter



The "Microsen" Pressure Transmitter picks up pressure motion with a Bourdon tube and by means of an electro-mechanical relay converts this motion to a stable and accurate DC signal. Transmitter case is cast aluminum, dust and vapor proof, with screwed-on covers. Standard pressure ranges up to 50,000 psi. are available. Combined resistance of the lead wire and indicator circuit may be any value up to 3000 ohms without affecting the transmitter's performance. Operating voltage is 115 at 50-60 cycle: power consumption is 2 watts. Manning, Maxwell & Moore, Inc.

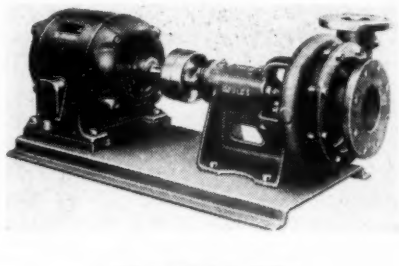
11—Laboratory Micro-feeder

A precise feed of microscopic proportions, such as required frequently in laboratory operations, is said to be possible with the new "Micro-Feeder." Useful for example in the injection of additives into pressure autoclaves, the unit will provide a smooth, uninterrupted flow through a capillary tube and injection needle. Capacity of the standard unit is 100 cc., with feeding rates as low as 1 cc./hr. Either change gears or variable speed drives are available to provide constant rate or flow proportional feeding. A synchronous 110 volt, AC, motor drive is automatically stopped when the limit of plunger travel is reached. A signal light and a four-figure totalizer are included. Proportioneers, Inc.



12—Centrifugal for Water

The Goulds "Figure 3769" centrifugal pump is a new design primarily for clear liquids, particularly water service. Absence of complicated parts and easy accessibility for repair works is said to make the pump easy to install and operate. Pumps are available in 14 sizes and have capacities ranging from 10 to 1800 gpm with heads up to 120 ft. Goulds Pumps, Inc.

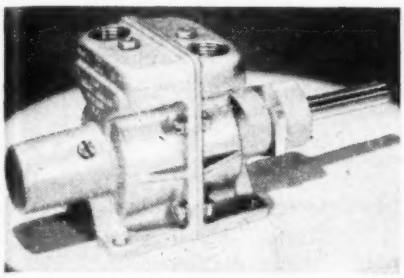


13—Dual-fuel Diesel Engine

The new Lima-Hamilton, 2-cycle, 21½ x 27½ in., dual-fuel Diesel engine features fast, easy changeover from gas to oil and oil to gas, and is said to be the first large engine of its type to operate satisfactorily on the low-pressure gas-injection principle. It is designed for operation on low-pressure gas with extremely low pilot fuel requirements. Requirement rates as low as 8-1/3 lbs./hr./cyl. have been observed under test of 90% load, according to the manufacturer. When arranged for dual-fuel operation, the net engine rating at 100% load is 425 hp./cyl. at 240 rpm., including blower requirements. Sizes from five to ten cylinders are available. A rotary valve in the exhaust outlet, along with an improved loop type scavenger, enables the cylinder to entrap nearly 40% more air than conventional 2-cycle Diesels, it is reported. Quick-closing valves in each cylinder and an underspeed governor are two safety devices for eliminating the usual hazards associated with gas operation. Lima-Hamilton Co.

What's New!

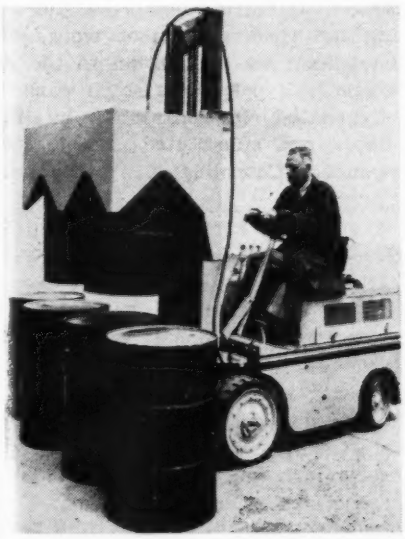
14—Pump Handles Viscous Fluids



A dual eccentric piston design in the "Eco Gearless" pump is said to give strong flow against pressure, enabling it to handle liquids and fluids in a wide range of viscosity. Self-lubricated bearings reduce the possibility of grease or oil fouling the intake and discharge lines. Pump body is made in naval bronze forgings or stainless steel castings. Available in four sizes, ¼, ⅜, ½, and ¾ in., the Eco pumps have capacities ranging from one to 12 gpm, against pressures from 0 to 100 psi., and delivering at speeds from 200 to 2400 rpm. Eco Engineering Co.

15—Four-drum Carrier

The recently announced "Tray-Hart" Multiple Drum Carrier, designed to pick up, carry and tier two or four 55-gal. drums without the use of a pallet, is now listed among special-handling attachments available on Clark fork trucks. The device fits over the top of the drums. Clamping shoes for gripping the drums are actuated by hydraulic power taken from the fork truck's hydraulic lift mechanism. The unit is quickly interchangeable with standard forks. Clark Equipment Co.

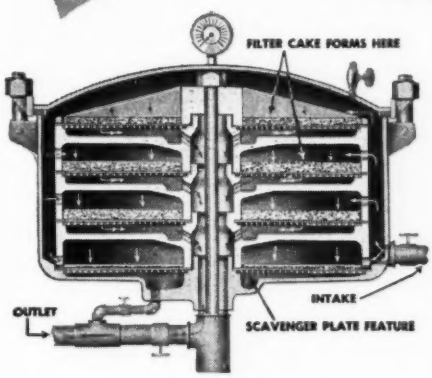


More "What's New!" Items, p. 94

Sparkler Filters

SPARKLER horizontal plate FILTERS

. . . keep petroleum products clean and free of foreign matter



The Sparkler horizontal plate method of filtration insures a firm, unbroken filter cake formed from diatomaceous earth or other filter media particularly suited to the liquid filtered. Such a filter cake removes even microscopic particles from any liquid ranging from light alcohols to heavy resin products.

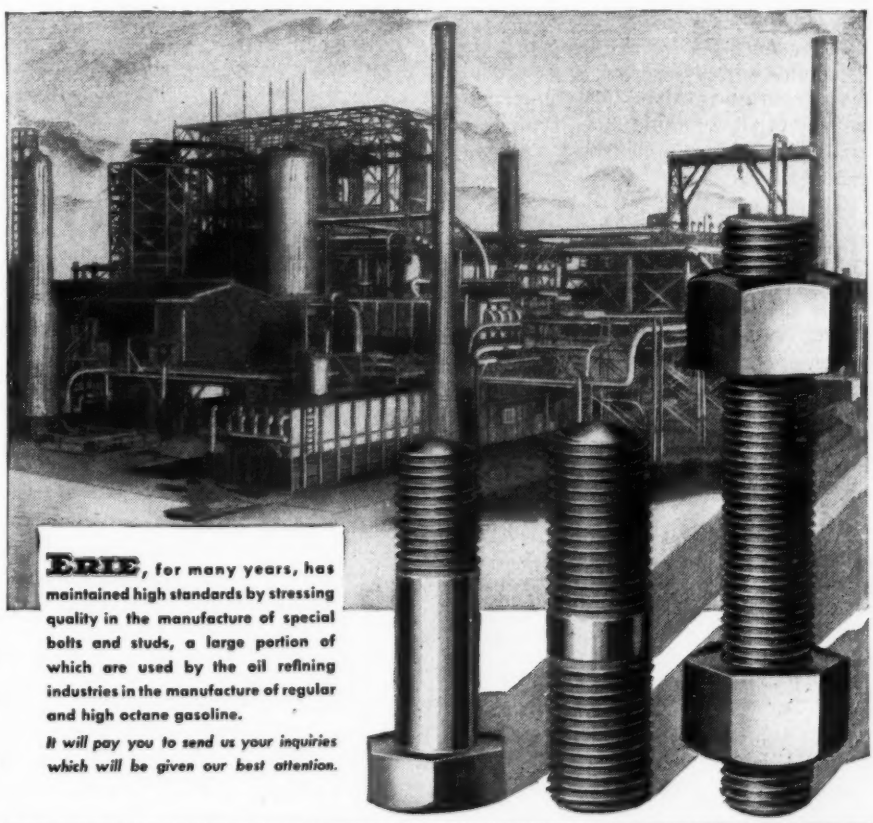
The petroleum refining and processing industry have available a filter in the Sparkler that solves many problems of keeping liquid petroleum products free from solids such as scale, rust, grit, and other foreign matter.

Domestic Fuel Oil

bulk plant operators can be sure of delivering clean clog-free fuel oil by filtering with Sparkler filters

Sparkler filters are available in capacities from small pilot plant models to built-in production line units of 5000 gallons per hour. The services of our staff of engineers with over a quarter of a century experience in solving filtration problems is available. Your problems will receive personal attention and individual analysis. Write Mr. W. J. Kracklauer, Sec'y & Treas.

SPARKLER MANUFACTURING COMPANY, Mundelein, Illinois



ERIE, for many years, has maintained high standards by stressing quality in the manufacture of special bolts and studs, a large portion of which are used by the oil refining industries in the manufacture of regular and high octane gasoline.

It will pay you to send us your inquiries which will be given our best attention.

ERIE BOLT & NUT CO.
ERIE, PA.

A SUBSIDIARY OF Barium STEEL CORPORATION Steelwright to the Nation

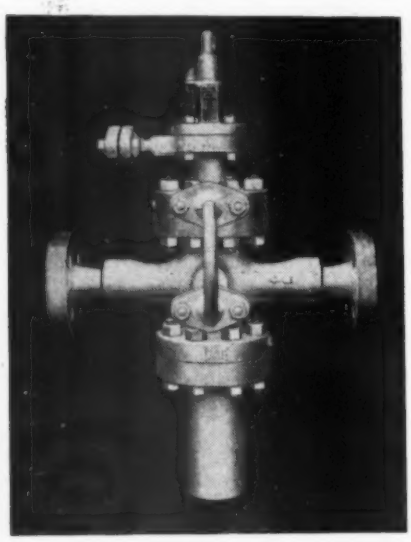
STUDS • BOLTS • NUTS ~ ~ ALLOYS • STAINLESS • CARBON • BRONZE

16—Miniature Control Station

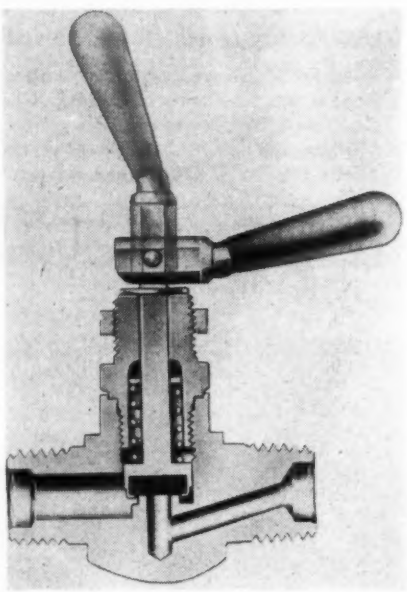
The "Nullmatic M/P" Control Station, requiring a miniature panel space of only 4-1/8 x 4-3/4 in., provides indication of process, control-point, and valve pressures, and includes transfer switches for "bumpless" manual-automatic changeover. Its small size has been designed for the newly-developed console desk and graphic type control panels as well as for standard panelboards. In the duplex indicator, a black pointer always shows the process value while a red pointer normally indicates the control-point-setting pressure. When a spring-return switch is thrown, this red pointer indicates the pressure on the diaphragm valve. The unit can be used for flow, liquid level, temperature, and other applications. Moore Products Co.

17—Pressure Reducing Valve

The Leslie Class "HS" pressure reducing valve employs internal pilot piston-operated construction and is designed for steam, air, or gas service. It handles inlet steam pressures from 300 to 1500 psi. and air or gas inlet pressures from 300 to 3000 psi. Reduced pressure range is from 100 to 600 psi. Maximum inlet temperature is 1000° F. Body is cast chrome-moly steel, with integral stellite seating surfaces. Valve is available in sizes 1, 1-1/4, 1-1/2, and 2 in. with Series 90 or 150 flanges or welding ends. Controlling valve is solid stellite. Cylinder liner and piston are hardened stainless steel. Diaphragm is monel. No change of spring or diaphragm is needed from minimum to maximum reduced pressure setting. Leslie Co.



18—Toggle Control Valve



The Hoke Toggle Valve, for control of high vacuum or pressure up to 500 psi., is designed for laboratory or industrial usage and is said to provide quick, positive action in opening or closing. Valve does not leak under pressure and can be used in place of common stop cock. It is available in brass or stainless steel with synthetic rubber seals, and in sizes 1/8, 1/4, and 3/4 in. in brass, and 1/8 and 1/4, in. in stainless steel. The valve is closed when the lever is down and opens fully when the lever is up. Hoke, Inc.

Trade Literature

19—Tubular Heat Exchangers

G-R Tubular Heat Exchangers, Bulletin 916; 32 pages on a complete line of this type equipment, along with tables of the characteristics of tubing, the thermal resistance of tubes and pipes of various alloys and metals, the specific gravity and lbs./gal. corresponding to degrees Baume and degrees API, and a chart of specific heats of midcontinent crude oils. The Griscom-Russell Co.

20—Petroleum Processing Index

Petroleum Processing Index for 1948; covers all special articles and stories as well as all regular departmental features for the 12 issues of the year. Classification by subject and by author, completely cross-referenced for ease of use. National Petroleum Publishing Co.

21—Lubricants and Additives

Aroclors, Physical Properties and Suggested Applications, Bulletin No. P-115: 28 pages on a line of chlorinated biphenyl and chlorinated polyphenyls, useful as air compressor lubricants, cutting oils, additives for high temperature or extreme pressure lubricants, in gaskets and packing materials, and also in adhesives and electrical insulation. Monsanto Chemical Co.

22—Thermocouple Manual

Wheelco Thermocouple Manual, Bulletin T/C 7; gives information on proper selection, installation, and testing methods, as well as current prices on thercocouples and accessories: includes temperature-millivolt curves, resistance tables, pipe and wire sizes, and lead wire conduit capacities. Wheelco Instruments Co.

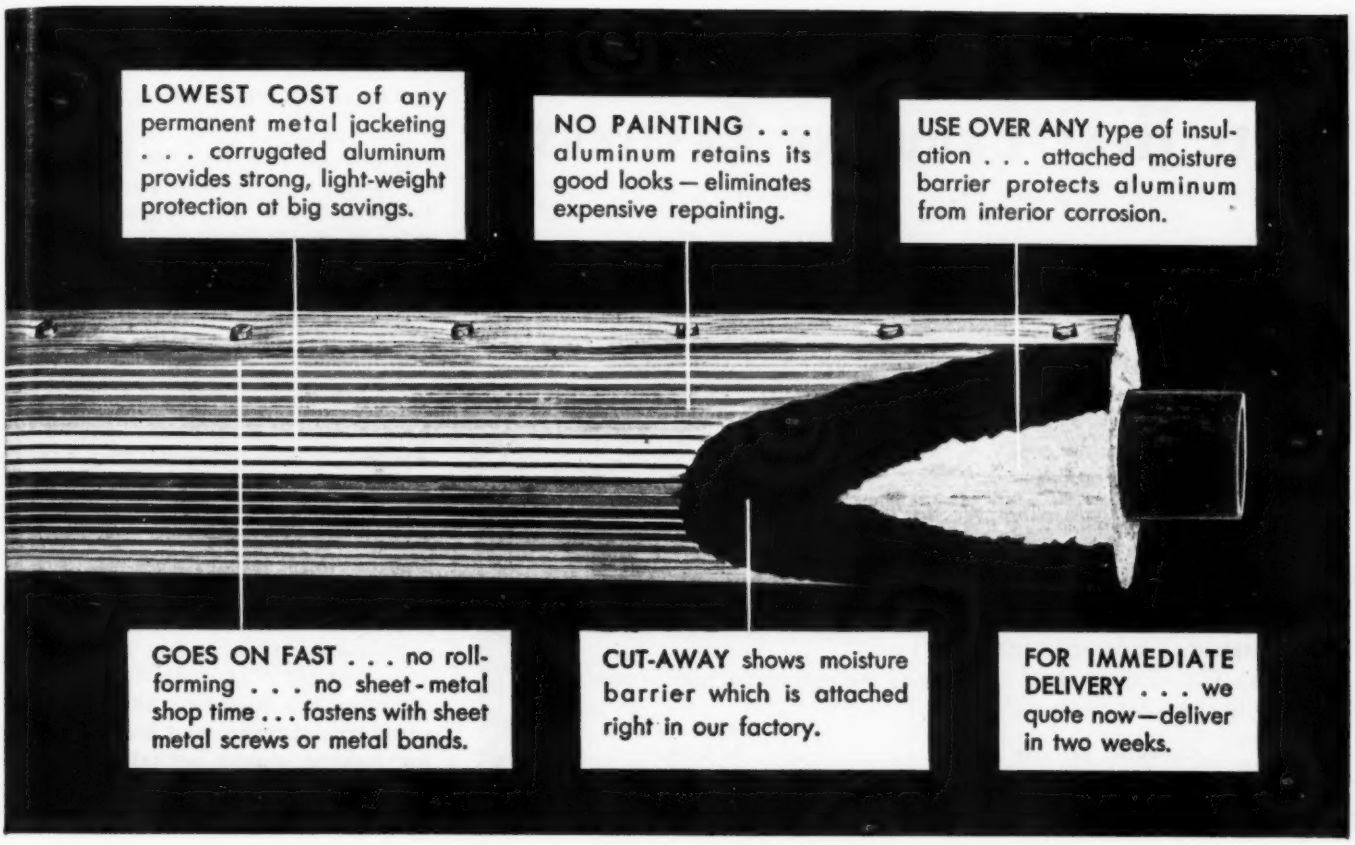
23—Mass Spectrometer

Consolidated Mass Spectrometer, Model 21-102; a 20-page booklet telling how the instrument works and describing its application to the analysis of petroleum hydrocarbons, oxygenated hydrocarbons, intermediates, and substituted organic compounds. Consolidated Engineering Corp.

24—Electronic Level Control

Leveltronic, Catalog No. 27; in addition to giving specifications and prices on two models of electronic level control relays, this booklet presents interesting applications for the instrument in controlling liquid interface, constant volume batch operating, temperature and pressure control. R-S Products Corp., Electronic Division.

More "What's New!" Items, p. 96


LOWEST COST of any permanent metal jacketing . . . corrugated aluminum provides strong, light-weight protection at big savings.
NO PAINTING . . . aluminum retains its good looks — eliminates expensive repainting.
USE OVER ANY type of insulation . . . attached moisture barrier protects aluminum from interior corrosion.
GOES ON FAST . . . no roll-forming . . . no sheet-metal shop time . . . fastens with sheet metal screws or metal bands.
CUT-AWAY shows moisture barrier which is attached right in our factory.
FOR IMMEDIATE DELIVERY . . . we quote now—deliver in two weeks.

ANNOUNCING: The first "engineered" metal jacketing for insulated lines

See how this new Childers Aluminum Jacketing solves your weather-protection problem.

NOW — Childers Jacketing gives you the weather-toughness of aluminum in a low-cost, easy-to-handle form. It requires no painting, it's weather-proof, it improves plant appearance, it comes complete with moisture barrier, and it's permanent.

And it gives you two big cost-saving advantages over other metal jacketing. Your first saving is provided by our glued-on moisture barrier. Metal jacketing needs a moisture barrier between it and the insulation. Using Childers Jacketing with the moisture barrier already attached, you cut and apply both jacketing and barrier all in one piece . . . in one operation instead of two.

You add another big saving because Childers Jacketing is easy to handle, and takes less field labor to apply. Shipped in 4-foot-wide rolls, by 100 feet long, it is easy to cut to size right on the job. It forms easily around the insulation . . . no roll-forming . . . no shop work.

Available now . . . two-week delivery on all orders. Examine this new kind of jacketing now. Send the coupon for a sample actually attached around a piece of insulation.

CHILDERS MFG. CO. DEPT. 4
625 YALE ST., HOUSTON 7, TEXAS

CHILDERS
ALUMINUM WEATHER-PROOF
Jacketing

Trade Mark

MAIL THIS COUPON FOR FREE SAMPLE

OK–Gentlemen–Show me just how good this jacketing of yours really is. Mail my sample to:

NAME _____ TITLE _____

COMPANY _____

STREET _____

CITY _____ STATE _____

BUY....

CALITE HEAT ENDURING CASTINGS

to

DEFINITE CHEMICAL AND PHYSICAL SPECIFICATIONS

This Will Assure

Uniform Quality and Service

STANDARD SPECIFICATION NO. 10-38

Heat Enduring Castings
For Industrial Furnace Construction
Grade "F"

CHEMICAL COMPOSITION:

(a) The castings shall conform to the following requirements as to chemical composition:

	GRADE "F"
Chromium, per cent	25.0-28.0
Nickel, per cent	10.0-12.0
Manganese, per cent	0.50-1.25
Silicon, per cent	0.25-1.75
Sulphur, maximum per cent	0.05
Phosphorus, maximum per cent	0.05
Carbon	Within limits of Paragraph 4 (c)

(b) The chemical limits for all other added alloying elements, such as molybdenum, titanium and nitrogen, shall be specified by the manufacturer. The material shall conform therewith.

CREEP STRESS AND CERTIFICATE:

(a) The indicated creep rate of the material shall not exceed 1% in 10,000 hours when stressed by a tensile load not less than the following:

TEMP. °F.	STRESS PER SQ. IN. 1% CREEP IN 10,000 HOURS GRADE "F"
1400°	4200#
1500°	3700#
1600°	3200#
1700°	2600#
1800°	1950#

(b) Manufacturer shall submit standard creep data and residual physical properties made on material of his own manufacture and certified by an ACCREDITED LABORATORY. The chemical analysis of the creep test specimens shall be reported, including nitrogen content and any other special alloying elements.

TENSION TEST FOR DUCTILITY AFTER HEATING:

(a) Each heat shall conform to the following requirements as to tensile properties after the specimen has been subjected to a temperature of 1400° F. for 24 hours and furnace cooled to 400° F. Test shall be made at room temperature.

	GRADE "F"
Tensile Strength, min.lb./sq.in.	80,000
Yield Strength, min.lb./sq.in.	35,000
Elongation in 2", min. per cent	9.0

Copy of complete specification will be mailed upon request

THE CALORIZING COMPANY

HEAT ENDURING AND CORROSION RESISTING METALS.
CALITE ALLOY CASTINGS — CALORIZED STEELS.

WILKINSBURG STATION **PITTSBURGH 21, PA.**

What's New!

25—Pump Maintenance

Metco News, Vol. 4, No. 5; presents a number of case histories on the use of metallizing various pump parts, both centrifugal and reciprocating, to salvage shaft, hubs, rods, plungers, pistons, and sleeves. Metallizing Engineering Co., Inc.

26—Fire Extinguisher Liquid

The Life Hazards and Nature of the Products Formed when Chlorobromomethane Extinguisher Liquid is Applied to Fires, Bulletin of Research No. 42; reports that this material falls into same classification as does carbon tetrachloride in its properties. Underwriters' Laboratories, Inc.

27—Steam Jet Blowers

Steam Jet Blowers and Blast Nozzles, Bulletin 4-AB; describes and illustrates the operation of a line of ventilating blowers and blast nozzles for furnace stacks, actuated by the steam jet principle; includes dimensions and prices. Schutte & Koerting Co.

28—Potentiometers

"ElectroniK" Potentiometers, Catalog No. 15-13, 32 pages covering constructional features and operating principles of strip and circular chart recorders and controllers, pyrometric switches, thermocouple assemblies, and the like; includes selection tables and detailed specifications. Brown Instrument Co.

29—pH and Conductivity

pH and Conductivity Recorders and Controllers, Catalog No. 15-12; discusses fundamentals of pH, oxidation-reduction potential, and conductivity and applications for instruments for measuring and controlling these properties. Brown Instrument Co.

30—Steam Separators

Wright-Austin Separators, Catalog No. 500; 24 pages on a line of separators, purifiers, receivers, and exhaust heads for steam, oil, air, and gas service; includes charts on steam flow and velocity in pipe, and pressure drop in steam piping. Wright-Austin Co.

31—Laboratory Equipment

Scientific Apparatus and Methods, Fall, 1948; a 44-page edition of a new quarterly publication includes articles on obtaining precise analyses with the polarograph and on purifying laboratory mercury, as well as latest catalog revisions. E. H. Sargent & Co.

32—Instrument Selection

Taylor Guide to Correct Instrument Selection, Bulletin 98170; explains with diagrams the actuating principle of three basic types of instruments in the company's line, along with special function devices and accessories. Taylor Instrument Cos.

33—Steam Generators

Cyclotherm Automatic Steam Generators, Bulletin P-1, presents diagrammatic sketches of the operating principle of a line of quick action steam boilers, gas or oil-fired, suitable for smaller requirements, in sizes from 10 to 300 hp. Cyclotherm Corp.

34—National Supply Company

The Story of The National Supply Co. is a 48-page history, illustrated with drawings and photographs, of one of the pioneering equipment suppliers, telling at the same time much of the story of the oil industry itself. The National Supply Co.

35—Steel and Alloy Forgings

The Improvement of Metals by Forging, a 44-page catalog gives details on the various types and characteristics of forgings, how to design for use of forgings, and how they are made, including carbon and alloy steels, corrosion-resisting steels, and high temperature alloys. Steel Improvement & Forge Co.

36—Safety and Relief Valves

Farris Safety and Relief Valves, Catalog 48; 72 pages on prices and descriptive data, including detailed index and comparison charts, and an engineering data section covering capacity tables, sizing tables, flange standards, hydrocarbon properties, and the like. Farris Engineering Corp.

37—Silicone Fluids

DC 200 Silicone Fluids, Dow Corning Silicone Notebook, Fluid Series No. 3: gives complete physical and chemical data on the liquid methyl silicones identified as "DC 200," and used as lubricants or additives, coatings, dielectrics, and hydraulic media. Dow Corning Corp.

38—Phosphor Bronzes

Elephant Brand Phosphor Bronze; a technical data booklet covering strip and sheet, wire rod, rope, castings, bushings, and ingots, along with special spring design and machinability data on a copper alloy useful in shafting, pump rods, bearings, valve parts, and electrical equipment. The Phosphor Bronze Corp.

39—Boiler Water Foaming

Ameroid Antifoam 8, Bulletin 8/5/48 RCU, Tentative; a technical pamphlet describing a new chemical product for the prevention of boiler water carryover from priming and foaming. E. F. Drew & Co., Inc.

40—Safety and Relief Valves

MIPCO Safety Relief Valves, Catalog No. 80; 24-page booklet describing complete line of valves for protection of pressure vessels and piping, boilers, compressors, heat exchangers, and the like. Marine & Industrial Products Co.

41—Additive for Concrete

The Effects of Calcium Chloride on Portland Cement; a 40-page booklet describing the beneficial use of this material in concrete construction, including graphs, tables, and charts; a bibliography; and a brief questions and answers section. Solvay Sales Division, Allied Chemical & Dye Corp.

42—Liquid Level Gage

Brown Instrumentation Data No. 10.4-1, lists applications and explains the operation of the "Gagetron" liquid level gage, manufactured by Engrg. Laboratories, Inc. Brown Instrument Co.

For Your Convenience

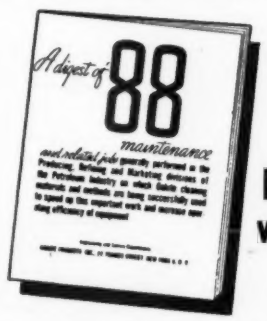
Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 88. Just circle the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

How to cut maintenance-cleaning costs

Producing Division
The 28-page Oakite Petroleum Digest offers step-by-step procedures for fast cleaning of pipe lines, pumping and drilling equipment, storage tank interiors, paint-stripping of Diesel and gas engines, and other related tasks.

Refining Division
Digest contains complete data on Oakite desludging and descaling techniques covering wide variety of heat exchange units. Describes how Oakite Compound No. 32, inhibited acid descalant, saves time and effort. Write for your copy TODAY!

Marketing Division
Here's valuable data for winter months: How to clean bulk fuel station headers and speed pumping from tanks to trucks. Other data includes procedures for floor cleaning, truck fleet maintenance, etc.



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Ample Quantities are now available. Samples are also available for experimentation. Write the nearest District Office for samples and also for Technical Bulletin on Du Pont "Ortholeum" 202.

TYPICAL PROPERTIES OF "ORTHOLEUM" 202

DESCRIPTION: A viscous, clear, amber-colored liquid with a terpenic odor.	
Specific Gravity, 60°/60°F.	1.14
Color, N.P.A.	4
Viscosity at 210°F., S.U.S.	110
Pour Point °F	+35
Flash Point, °F. (C.O.C.)	235
Fire Point, °F. (C.O.C.)	255
Ash	Trace
Miscibility in Oil at room temperature	in all proportions
Sulfur, %	35
SULFUR ACTIVITY, COPPER STRIP*	
3 HOURS AT 210° F.	
0.5%	Light to Medium Brown
5.0%	Black
1 HOUR AT 250° F.	
0.5%	Medium Brown
2.5%	Black
1 HOUR AT 300° F.	
0.5%	Dark Brown
2.5%	Black

*VV-L-791c, Method 530.31, except for variations in time and temperature as noted.

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Lubricating Oil Additives

Fuel Oil Additives

Gasoline Dyes

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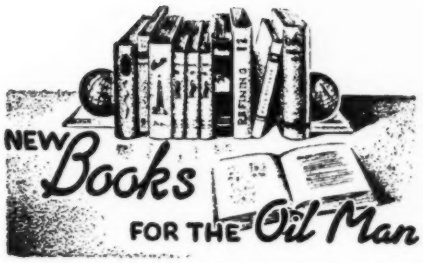

Unless otherwise indicated, copies of all books reviewed here may be ordered from the Reader's Service Department, Petroleum Processing, 1213 West Third Street, Cleveland 13, Ohio, for the price listed, postpaid. Ohio purchasers please add 3% tax. NOTE: publisher's prices are subject to change without notice.

First Postwar Year Recorded In Latest Minerals Yearbook

Minerals Yearbook, 1946; 5¾ x 9 in., 1638 pages, stiff cloth binding, indexed, $3.75. (1948).

This latest annual issue of the Bureau of Mines *Minerals Yearbook*, 1946 edition, covers the first full postwar year, a period of tremendous transition from a wartime to a peacetime economy. The book has been made considerably easier to use through one important change in format: the individual chapters on specific minerals have been arranged alphabetically. In addition, easier-to-read typeface has been employed for principal headings, side headings, and table captions.

The foreign mineral review, inaugurated two years ago in the 1944 edition, has been retained. In the present volume, this section deals with Middle and South America. Of particular interest to all engineers, technologists and scientists is a chapter in the section on Commodity Reviews devoted to Uranium and Thorium.

Include Five Method Changes In 1948 Petroleum Standards

A. S. T. M. Standards on Petroleum Products and Lubricants, 1948 Edition, American Society for Testing Materials Committee D-2; 6 x 9 in., 764 pages, indexed, paper binding, $5.50; cloth binding, $6.15. (1948).

This latest edition of the *ASTM Standards on Petroleum Products and Lubricants* contains important changes in all five of the ASTM Engine Test Methods for Rating Fuels that have been adopted by the Society during 1948.

The Detonation Meter, Model 501, approved as optional equipment to the bouncing pin in the Motor and Research Methods for octane numbers of motor fuels, is covered with complete details on design, installation, and operation. In addition, there is a report on an investigation as to whether the Meter gives the same results as the bouncing pin. It covers results from 15 laboratories and includes some 858 comparative ratings by the Motor Method and 483 by the Research Method.

The sections in the book on Reproducibility in the Motor, Research, Aviation, Supercharge, and Cetane Methods are each revised to show the number of tests required to obtain a desired accuracy. This same information will also be published in a 1948 *Appendix* to the *ASTM Manual of Engine Test Methods for Rating Fuels*, scheduled for appearance in December, 1948.

The present volume of the Products and Lubricants Standards now includes 93 test methods and specifications in approved form and 53 in tentative form. They are arranged numerically; however, there also is a detailed table of contents listing them according to the general fields covered, as well as a subject index.

Included in the appendix as information only are ten proposed methods of test, the reports on the detonation meter, and a set of recommendations on the form of ASTM Methods of Test for Petroleum Products and Lubricants. The ten proposed standards include:

1) Performance characteristics of wheel bearing grease, 2) separation of residue from butadiene, 3) determination of butadiene dimer in polymerization grade butadiene, 4) non-volatile residue of polymerization grade butadiene, 5) factors and tables for volume correction and specific gravity conversion of liquefied petroleum gases, 6) sulfur in petroleum oils by quartz tube combustion, 7) sodium in lubricating oils and additives, 8) measuring the temperature of petroleum and petroleum products, 9) analysis of calcium and barium petroleum sulfonates, and 10) benzene and toluene by ultraviolet spectrophotometry.

Pressure Relieving Systems

Reprints have been prepared of the series of articles on "Design and Construction of Pressure Relieving Systems" which appeared in the July, August and September, 1948, issues of PETROLEUM PROCESSING. A limited number are available for distribution and single copies will be sent without charge to readers requesting them.

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MEETINGS . . . for the Oil Man

JANUARY

10-14, Society of Automotive Engineers, Annual Meeting and Engineering Display, Book-Cadillac Hotel, Detroit.

FEBRUARY

10, Chemical Market Research Assn., Biltmore Hotel, New York.

28-Mar. 4, American Society for Testing Materials, Spring Meeting and Committee Week, Hotel Edgewater Beach, Chicago.

MARCH

27-Apr. 1, American Chemical Society, 115th National Meeting (headquarters for Division of Petroleum Chemistry, Mark Hopkins Hotel), San Francisco.

28-30, Western Petroleum Refiners Assn., Plaza Hotel, San Antonio, Texas.

APRIL

4-7, American Petroleum Institute, Division of Refining, Shamrock Hotel, Houston.

11-13, American Society of Lubrication Engineers, Hotel Statler, New York.

11-14, National Assn. of Corrosion Engineers, 5th Annual Conference and Exhibition, Netherlands-Plaza Hotel, Cincinnati, Ohio.

13-15, National Petroleum Assn., Hotel Cleveland, Cleveland.

20-22, Natural Gasoline Assn. of America, Texas Hotel, Ft. Worth, Texas.

MAY

9-11, Liquefied Petroleum Gas Assn., Meeting and Trade Show, Palmer House, Chicago.

12-13, Instrument Society of America, 4th Annual Spring Meeting, Royal York Hotel, Toronto, Canada.

JUNE

5-10, Society of Automotive Engineers, Summer Meeting, French Lick Springs Hotel, French Lick, Ind.

9, Chemical Market Research Assn., Annual Business Meeting, Biltmore Hotel, New York.

27-July 1, American Society for Testing Materials, 52nd Annual Meeting, Hotel Chalfonte-Haddon Hall, Atlantic City, N. J.

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Personals

E. H. Walker, general manager of Shell Oil Co.'s personnel and industrial relations organization, has been appointed a vice president. Increased activities are planned for the organization.

Mr. Walker

A graduate of Louisiana State University, he started with Shell in 1932 in the storehouse at the Norco refinery. After wide service in the engineering and operating departments at Norco, he was transferred to St. Louis in 1936 as personnel assistant in the manufacturing department. In 1940 he was moved to New York as manager of the personnel department and in 1943 was named to his present position.

* * *

J. Harold Perrine, administrative assistant in the research and development department of Sun Oil Co., has been elected a trustee of Grove City College, Grove City, Pa.

* * *

J. B. Rather, member of and technical adviser to the manufacturing committee, Socony-Vacuum Oil Co., Inc., has retired and is moving from Brooklyn to San Antonio, Texas. He started with the company in 1918, became chief chemist in 1919 and from 1932 to 1934, when he took his present position, was general manager of the research, development and technical service laboratories.

* * *

Charles Francis Fleming, employed for 11 years in the East Chicago refinery of Socony-Vacuum Oil Co., Inc., took office Dec. 2 as Secretary of State in Indiana. He had served in the state senate since 1941. A native of Des Moines, Ia., he is a graduate of Indiana University.

* * *

Dr. Eugene P. Schoch, director of the Bureau of Industrial Chemistry, University of Texas, is the first recipient of the Southwest Regional Award established by 21 sections of the American Chemical Society in recognition of outstanding contributions by a chemist or chemical engineer in the southwest to the chemical profession, science of chemistry and the chemical industry.

Among numerous other achievements Dr. Schoch developed a method for producing acetylene from natural gas by a low-temperature "glow" electrical discharge. It is planned to build a plant in Houston utilizing the process.

* *

V. E. Middlebrook has resigned as manager of Shell Oil Co.'s gas-gasoline operations in the Mid-Continent area to become an engineering consultant with offices in the Citizens National Bank Bldg., Tulsa. His career has included association with Coltexo Corp., Phillips Petroleum Co., Texas Empire Pipe Line Co., and Shell Oil for the past 12 years. His work has included designing and building natural gasoline, propane and butane recovery plants.

* * *

Adolphus C. Pilger, Jr., automotive engineer, Tide Water Associated Oil Co., New York, is the recipient of the 1947 Horning Memorial Award of the Society of Automotive Engineers. His contribution was a paper entitled "Field Testing of Motor Oil and Gasoline," presented at the 1947 SAE summer meeting, which described a new technique for predicting engine deposits of sludge and varnish and bearing corrosion, and which evaluates engine lubricants and gasoline when engine design factors and operating conditions are known. The award, memoralizing the life work of the late Henry L. Horning, is granted for new contributions to the adaptation of fuels to engines and of engines to fuel.

Mr. Pilger

A native of New Jersey, Mr. Pilger graduated from Rutgers University in 1934 with a B. S. in mechanical engineering. He joined Tide Water in 1936.

* * *

Irving N. Simmons is head of Houdry Process Corp.'s Patent Division, and will be responsible for the development and maintenance of the company's patents. He graduated from Tufts College with a degree in chemical engineering, has been with Houdry Process since its founding in 1931 and became associated with the patent division in 1934.

Mr. Simmons

* * *

J. D. Lykins is assistant manager of the Standard Oil Co. (New Jersey) London office for foreign refining coordination. He was formerly division superintendent in the process department of Lago Oil & Transport Co., Ltd., at Aruba, N. W. I.

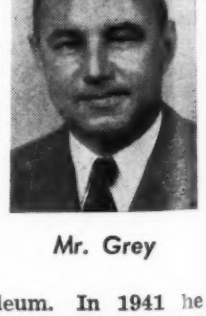
* * *

D. S. Mellett has been transferred to assist in the engineering of a refinery for the Mediterranean Refinery Co., subsidiary of Socony-Vacuum Oil Co., Inc., with offices in New York. He was formerly in the engineering department of the Socony-Vacuum refinery at Trenton, Mich.

* * *

Edward R. Grey is superintendent of Mexican Petroleum Corp. of Georgia's refinery at Savannah.

His career in the petroleum industry started at the age of 14 when he began to work summers in a refinery at Destrehan, La. Shortly after graduating in chemical engineering from Tulane University in 1932 he was employed at the Texas City refinery of Pan American Refining Corp., an affiliate of Mexican Petroleum. In 1941 he was transferred to Savannah as chief engineer and in 1944 was promoted to assistant superintendent in charge of construction and maintenance.



Mr. Grey

1948 Index Ready

The annual subject and author index of all material published in PETROLEUM PROCESSING during 1948 is now ready. You may secure your copy without charge by requesting Item No. 20 (see pg. 94) on this month's "What's New" card. Or send your request to:

Reader's Service Department

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Richard S. Stewart is assistant to C. T. Foster, executive vice president of Standard Oil Co. (Ohio) starting Jan. 1. He has been operations manager for the manufacturing department since 1945.

Mr. Stewart

Graduating from Cornell with an M. E. degree in 1932 Mr. Stewart worked 6 years in engineering capacities for The Texas Co., and started with Sohio as a power engineer in 1938. He became assistant to the chief engineer in the manufacturing department, assistant for industrial relations to the vice president in charge of manufacturing, and in 1944 took on additional duties as secretary to the manufacturing advisory committee.

During the war he was the Sohio representative to the PAW on the construction of its aviation gasoline units and he was also on special assignment with the Navy.

Ten promotions in the Sohio manufacturing department's four refineries and home office, made possible by its $100,000,000 expansion program, have been announced by E. B. McConnell, vice president in charge of manufacturing.

Wallace K. Bergen, manager of the Toledo refinery, succeeds Mr. Stewart as operations manager. He joined Sohio at the old Solar refinery in Lima in 1930, went to the Latonia, Ky., refinery in 1933, and in 1940 was transferred to the Toledo refinery, becoming manager in 1945.

Ivan L. Peterson, now manager of the Lima refinery, will become manager at Toledo, where he was first employed by Sohio in 1924. Later he was assistant superintendent and superintendent of maintenance and construction at the Cleveland No. 1 refinery and in October, 1945, became superintendent of the Lima refinery.

Seward R. Bolles, now manager of the Latonia refinery, will become manager of the Lima refinery. After World War I, he joined The Standard Oil Co. (New Jersey) and in 1929, joined Sohio at the Toledo refinery. After experience there and at the Solar refinery and the home office, he was transferred to the Latonia refinery in 1937 as assistant superintendent.

Edward S. Bale, now general superintendent at Cleveland No. 1 refinery, will become manager of the Latonia plant. He joined Sohio in 1939 as process engineer at the Toledo refinery, and in 1944 was transferred to Cleveland No. 1 refinery.

James S. Dalton, general superintendent at Latonia refinery, will become general superintendent at Cleveland No. 1 refinery. He has been with the company 19 years.

Ray Elo, who joined Sohio in 1934 at Latonia, will become plant superintendent there.

Joseph August, now chief of the Technical Service Division in Cleveland, who joined the company in 1938, will become technical superintendent of the Lima Refinery, which is now being doubled in size.

Donald G. Stevens, who joined Sohio in 1941, will become chief of the Technical Service Division of the manufacturing department.

Edward N. Salathe, now chief engineer at Cleveland No. 1 refinery, where he started in 1936, will succeed Mr. Stevens as supervisor of the Design and Construction Section of the General Engineering Division at Cleveland.

Norman C. Fuller started at Cleveland No. 1 refinery in 1946 and will become chief engineer, succeeding Mr. Salathe.

* * *

E. C. Ayres is superintendent of Phillips Chemical Co.'s (Phillips Petroleum) new fertilizer plant at Port Adams, Texas, near Houston. He was formerly assistant superintendent of the Cactus plant in the Texas Panhandle. **Austin Morgan,** of the Cactus plant, succeeds Mr. Ayres as assistant superintendent there.

A. E. Lacomblé, president of Shell Development Co. since 1943, Jan. 1 became chairman of the board, being succeeded as president by **M. E. Spaght,** formerly vice president.

Mr. Lacomblé

Mr. Lacomblé joined Shell in 1920 after receiving his doctorate in science from the University of Leyden in Holland. After serving in the Dutch East Indies, he became assistant superintendent of the Martinez, Cal., refinery in 1926. In 1936 he was made vice president in charge of manufacturing for Shell Petroleum Corp., St. Louis. He later became chairman of the executive committee of Shell Development Co. and in 1943 became president.

* * *

R. L. Rorschach is on leave of absence from his position as junior engineer with Stanolind Oil & Gas Co., Tulsa, to study for an advanced degree in chemical engineering at Massachusetts Institute of Technology.

* * *

David C. Clark, Jr., is junior engineer in the technical service depart-

Letter from Chemist in Berlin

Berlin, 25. Oktober 1948

Dear Sirs,

I have found your address in scientific literature and by making use of it I beg your apology and ask you to exercise some measure of understanding. I know no other way of approach having no other addresses of chemical industries in your country. Perhaps you would find it possible to forward my letter if needs be in an appropriate direction.

In view of the fact that in Germany for an unlimited time there will hardly be a possibility for satisfying work—lack of material, equipment, etc. make research work practically impossible—I have the desire as specialist in scientific chemistry to find a new homeland and a new sphere of labour.

According to present day regulations the possibility for emigration is only being if a firm of a country extends an invitation and offers an engagement.

I was born in Berlin on September 20th, 1915 and I studied at the local University up to the graduation for my degree of Doctor of Science. Following that I worked in the industries, research laboratories up to the time when a year ago I returned to the Berlin University in the capacity as research assistant. Alongside with my practical work I worked for a considerable time as coworker for the magazine "Chemisches Zentralblatt" (Central Magazine for Chemistry).

The particular objects of my research work were oxydation of paraffin, high pressure hydrogenation (Furfurol), special inorganic and organic compositions of aluminum, disinfectants, plastifiers, emulsifiers, detergents.

I am married, have no children. If you find it possible please let me have a reply.

Yours truly,
Dr. M. R.

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BALL-BEARING SWIVEL JOINTS FOR ALL PURPOSES

ment of the Baytown refinery of Humble Oil Refining Co. He recently received his M.S.E. degree in chemical engineering from the University of Michigan.

* * *

H. D. Wilde, manager of the technical and research division, Humble Oil & Refining Co., Houston, and **I. L. Murray,** assistant superintendent of engineering, Carbide and Carbon Chemicals Corp., South Charleston, W. Va., are new directors of the American Institute of Chemical Engineers.

* * *

J. A. Ramsey, formerly superintendent of Continental Oil Co.'s Wichita Falls, Tex., plant, has been named superintendent of the company's $9,200,000 refinery under construction at Billings, Mont., due to be completed in 1949.

Mr. Ramsey

This new assignment is a return to the Rocky Mountain region for Mr. Ramsey, who was superintendent of Continental's refinery at Glenrock, Wyo., from 1941 to 1945. He joined Continental in 1926 as a pipefitter's helper at Ponca City. From pressure still foreman there in 1935 he was promoted to assistant superintendent of the Wichita Falls refinery and 1941 went to Glenrock. He returned to Wichita Falls as superintendent in 1945.

Mr. Markey

Succeeding Mr. Ramsey as superintendent at Wichita Falls is **J. P. Markey,** formerly assistant superintendent. He has been with Continental 18 years, beginning as a tester at Ponca City, following his graduation from Loyola University. He served as resident chemist of the Denver refinery and went to Farmington, N. M., in 1937 to become refinery superintendent there. He was transferred to Wichita Falls in 1941 as assistant superintendent.

Norman Newton, former resident chemist at Wichita Falls, has been promoted to assistant superintendent, succeeding Mr. Markey. A chemical engineering graduate of Purdue University, Mr. Newton joined Continental as a chemist at Florence, Col., in 1925, later served at Artesia, N. M., and in 1926 went

to Wichita Falls as a chemist. He advanced to resident chemist there in 1937.

Malcom Lider, a graduate of Baylor University, began work with Continental in 1940 as a tester at Wichita Falls and now is advanced from assistant resident chemist to resident chemist, succeeding Mr. Newton.

Succeeding Mr. Lider is **M. E. Oliver,** a graduate of the University of Kansas, who came to Continental's Ponca City refinery in 1947 as analytical chemist, and now is transferred to Wichita Falls as assistant resident chemist.

* * *

George C. Hargrove is vice president in charge of general administration and sales of E. B. Badger & Sons Co., Boston. He has been with the company for 18 years. **Ralph D. Waterman** is vice president in charge of engineering and construction. He has been with the company for nine years. Both were elected at a recent meeting of the directors.

* * *

Ralph F. Wolf is manager of compounding research for the Columbia Chemical Division of Pittsburgh Plate Glass Co. A graduate in chemical engineering from Catholic University of America, during the war he was chief of the synthetic rubber allocation section of the War Production Board and, prior to the war, he was manager of synthetic rubber compounding research for Standard Oil Development Co.

* * *

John G. Ditman is a process design engineer for lubricating oil and wax projects with Foster Wheeler Corp., New York. He was a chemist in the petroleum technical service department of Esso Standard Oil Co., Louisiana Division.

* * *

Ram Dev is a chemical engineer in the Socony-Vacuum Oil Co., Inc. research and development department, Paulsboro, N. J. He was in Montana State College as a Government of India scholar and expects to return to India in a year.

* * *

Walter Fowkes is on the staff of the U. S. Bureau of Mines Oil Shale Experimental Station, Laramie, Wyo. He was formerly with Houdry Process Corp.

* * *

Dr. Wayne E. White, Ozark-Mahoning Co., is chairman of the Tulsa Section of the American Chemical Society, succeeding **Dr. Paul H. Cardwell,** Dowell, Inc., who was named section representative on the ACS National Council.

J. L. Burkitt, Mid-Continent Petroleum Corp., is vice chairman of the Tulsa section. **Dr. Alfred Steitz,** Stanolind Oil & Gas Co. is secretary; **Dr. D. D. Hartley,** Mid-Continent Petroleum Corp., treasurer, and **R. W. Provine,** also of Mid-Continent, alternate councilor.

* * *

William Schwarz is general manager refineries-Europe, for California Texas Oil Co., and is to establish a Paris office to coordinate refinery construction for the company in Europe. He has been in the oil industry for 20 years and since 1944 was manager of the Ultramar SAPA refinery of Caltex in Buenos Aires.

Mr. Schwarz

Other Caltex promotions include; **R. W. Parker** to assistant chief engineer, construction and maintenance; **W. E. Tucker** to assistant chief engineer, designs; **J. W. Thomas** to petroleum engineer.

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EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

Congress Will Have Another Go At a Science Foundation Law

A NEW SCIENCE FOUNDATION BILL providing for government support and control of research in the interests of national defense and public welfare will undoubtedly be presented to the Congress now convening. Proposals for such a tax-supported research program have been before the public since the war, the principle having the support of many industrialists and scientists as a means for co-ordinating the work of a great many independent agencies and institutions, and directing it in channels likely to be of the most benefit to the public. The differences which have developed among proponents of a federally sponsored Science Foundation have been chiefly along two lines:

1—Shall the direction of the research program be left in the hands of a board of the nation's top scientists, subject to what be termed the long-range control of the President and Congress? Or shall it be in the hands of a Science Foundation Director appointed by the President and thus directly subject to the political influence that besets all appointed officials?

2—Shall inventions arrived at in the course of work on projects under the Science program remain the property of the inventor subject to the provisions of our present patent laws? Or shall the fruits of any invention arrived at in work on any research project sponsored in any way by the government become government property through its automatic ownership of resulting patents?

A Science Foundation bill was passed by Congress in 1947, but was vetoed by President Truman because it did not provide for the appointment of the Director by the President. The Senate in 1948 passed a bill that met the President's wishes in this respect and also made possible a great delving into the so-called social sciences, at the tax-payer's expense; the jam of final legislative matters in the House prevented its being brought up for vote before adjournment.

Industrial scientists did not present their views on the Science Foundation very impressively at the committee hearings on the 1948 bills. Those who were heard were mostly heads of institutions and theorists with pet ideas who stood to benefit from grants of funds.

The proponents of a Science Foundation law that would set up another federal bureaucracy to spend government funds lavishly, and where political influence could be brought to bear on projects undertaken, will be pressing their views even more vigorously on the new Congress. The bill that died in the last Congress may be brought out and passage urged without the customary public hearings, because of the lack of opposition in the 1948 hearings.

This the petroleum and other industries should oppose. In the public interest hearings should be demanded and the industrial scientists should again present their case for a Science Foundation directed by scientists and with the rights of inventors protected as under the present patent system, where real progress may be made towards new goals in the field of research.

What Fuel Yardstick in Studying Mechanical Antiknock Improvers?

MOST OF THE CAR MANUFACTURERS are said to be experimenting with the Thompson Vita-Meter, dual fuel carburetors and undoubtedly other means as well for achieving higher antiknock performance in engines from currently available fuels. This indicates that the automobile industry, as well as the oil companies, recognize that the point is being reached where the refiner is not economically justified in installing the new plants to produce motor fuels of sufficient antiknock quality to meet the needs of the higher compression engines the automobile manufacturers would like to make.

However, improved performance is only one criterion in studying mechanical means for getting the benefit of higher octanes from the present motor fuels. More important still is the possible effect of the widespread usage of such devices on the general conservation of our motor fuel supplies.

For example, the test work with the Vita-Meter as a means for injecting an alcohol-water, anti-detonant fluid as needed, which has thus far been made public, has involved the use of a low end point, straight-run gasoline, as compared with performance with highly leaded regular grade cracked gasoline without injection of the anti-detonant fluid. Widespread use of the device now with straight-run gasoline only would create a demand for this product which the refining industry might have difficulty in meeting, since not over 20% maximum of straight-run gasoline can be taken from the crude supply.

A truer perspective can be had on these mechanical means for achieving better antiknock performance when they are used with cracked gasolines of the nature which refiners now manufacture and supply in largest volume. Providing better performance and improved efficiency for these fuels would be a real contribution to conservation.

Petroleum—Our Chemicals Resource

Winning of the 1948 award for Chemical Achievement by Shell Development Co. serves to high-light the developments of the past few years in the commercial manufacture of chemicals from petroleum hydrocarbons. The specific citation to Shell is for the first successful synthesis of glycerine from petroleum on a commercial scale. The award likewise recognizes the long-time program of pioneering research by this company, which has already resulted in the commercial manufacture of other petrochemicals and laid the groundwork for more to be brought out in the future.

Another recent report is proof that the work of other oil companies in petrochemical research is bearing fruit. Esso Standard Oil Co. is commercially producing a new synthetic alcohol, iso-octyl, from a naphtha fraction and carbon monoxide gases at its Baton Rouge refinery. A wide field of industrial usefulness is seen for this and other higher alcohols which may be produced by its process.

CHEMICAL USERS' GUIDE

to General Chemical Products for the Petroleum Industry

ALKYLATION

ANHYDROUS HYDROFLUORIC ACID
Grades or Strengths: 99.0% HF min. (one grade only)
Packing: Steel Cylinders, Tank Cars

SULFURIC ACID
Grades or Strengths: Standard
66° Baume—93.19% H_2SO_4
99% H_2SO_4
Diamond—66° Baume
Sulfuric Acid, Crystal—66° Baume
Packing: Tank Barges, Steel Tank Cars, Steel Tank Trucks, Steel Drums, also Carboys

OLEUM
Grades or Strengths: 15% free SO_3 (103.38% H_2SO_4)
20% free SO_3 (104.5% H_2SO_4)
65% free SO_3 (114.38% H_2SO_4)
Packing: Steel Drums, Tank Cars, Tank Barges

POLYMERIZATION or ALKYLATION

FLUOSULFONIC ACID—$HO{:}SO_2F$ (HSO_3F)
Grades or Strengths: Min. Content 98% Fluosulfonic Acid
Packing: Steel Tank Cars, Steel Drums

BORON TRIFLUORIDE, Ether Complex
Grades or Strengths: 47.88% min. BF_3
Packing: 5, 20 and 55 Gal. Drums; for Bulk Quantities write Baker & Adamson Products, General Chemical Division, Allied Chemical & Dye Corporation, 40 Rector St., N. Y. 6, N. Y.

SULFONATION

SULFURIC ACID

OLEUM

SODIUM SULFATE, Anhydrous
Grades or Strengths: Standard, approximately 99.5% Na_2SO_4
Packing: Multiwall Paper Bags

ISOMERIZATION

MURIATIC ACID (Hydrochloric)
Grades or Strengths: Standard—18°, 20°, and 22° Baume
Packing: Rubber-lined Tank Cars, Rubber-lined Tank Trucks, also Carboys

DETERGENTS

SODIUM METASILICATE
Grades or Strengths: Granular, thru 10 mesh; Powdered, 90% thru 40 mesh
Packing: Multiwall Paper Bags, Fibre Drums

DISODIUM PHOSPHATE
Grades or Strengths: Anhydrous
Packing: Multiwall Paper Bags, Fibre Drums

TRISODIUM PHOSPHATE
Grades or Strengths: Coarse, thru 10 on 20 mesh; Medium, thru 20 mesh on 100 mesh; Standard, thru 20 mesh, 15-25% thru 100 mesh; Fines, thru 40 mesh, 50% thru 100 mesh
Packing: Multiwall Paper Bags, Fibre Drums

TETRASODIUM PYROPHOSPHATE
Grades or Strengths: Anhydrous, Powdered, 100% thru 20 mesh, 90% min. thru 100 mesh
Packing: Multiwall Paper Bags, Fibre Drums

TREATING AGENTS

ALUMINUM SULFATE
Grades or Strengths: Standard-Lump, ¾"-2½" approx.; Ground, thru 8 mesh, 95% thru 10 mesh; Powdered, 97% thru 100 mesh; also Iron-Free Grade
Packing: Multiwall Paper Bags, Carloads in Bulk.

SODIUM SULFATE, Anhydrous

ACIDIZING

MURIATIC ACID (Hydrochloric)

MUD CONDITIONING

SODIUM SILICATE
Grades or Strengths: Clear and Opalescent Grades in a wide range of viscosities ranging from 38° to 60° Baume
Packing: Steel Drums, Tank Cars, Tank Trucks

DISODIUM PHOSPHATE

TRISODIUM PHOSPHATE

TETRASODIUM PYROPHOSPHATE

OTHER CHEMICALS

AQUA AMMONIA

SODIUM FLUORIDE

NITRIC ACID

HYDROFLUORIC ACID, 60%

OTHER HEAVY CHEMICALS

CATALYSTS and SPECIAL CHEMICALS

Companies requiring catalysts, addition agents, inhibitors, or other special chemicals "tailor-made" for their individual processes are invited to consult with General Chemical on their requirements. The same progressive research, technological "know how," and practical experience that has found the answer to so many petroleum chemical problems during General's long service to the Industry may provide the solution to yours, too.

The products advertised herein are commercial chemicals having various uses, some of which may be covered by patents, and the user must accept full responsibility for compliance therewith.

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Interior view of a 14' 3" x 110' fractionating tower showing installation of one of the stainless steel bubble trays to complete another superior fabrication by Wyatt's for the Petroleum Industry.

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